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POSTLAUNCH REPORT FOR APOLLO MISSION A-004

(Spacecraft 002)

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April 15, 1966

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-167

November 6, 1967

AN ANALYSIS OF THE LAND IMPACT PROBLEM DURING MODE I ABORTS FROM THE SATURN IB LAUNCH VEHICLE

By Samuel R. Newman
Robert E. Prahl
and
Dallas G. Ives

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO.67-FM-171

November 13, 1967

THE LUNAR LANDING MISSION SMRCS PROPELLANT BUDGET AS DEFINED FOR THE CONFIGURATION CONTROL BOARD

By Consumables Analysis Section

(This document supersedes 67-FM-155 dated October 20, 1967)

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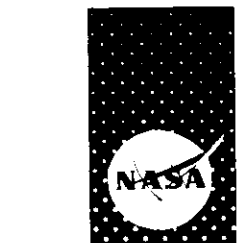

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO.67-FM-172

November 13, 1967

ONE-DIMENSIONAL MINIMIZATION USING SEARCH BY GOLDEN SECTION AND CUBIC FIT METHODS

By Ivan L. Johnson, Jr.
Mathematical Physics Branch
and
Geraldine E. Myers
Analytical Mechanics Associates, Inc.

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 67-FM-173

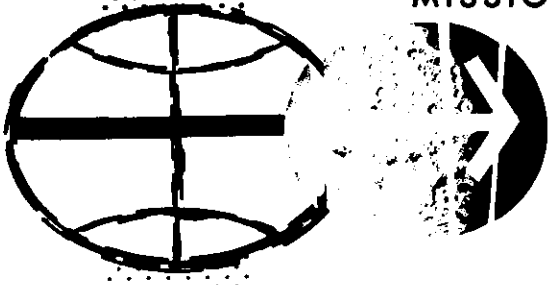
November 15, 1967

FEASIBILITY OF MANUAL COMPLETION OF A LOI BURN

VOLUME I - IMU DRIFT ABOUT THE PITCH AXIS

By Alexander H. Treadway
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

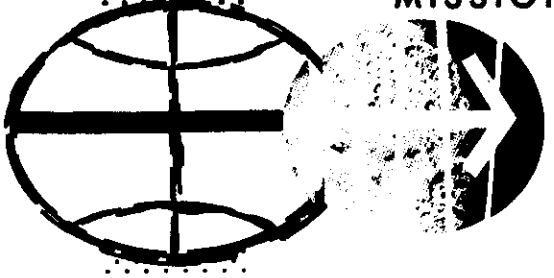
MSC INTERNAL NOTE NO. 67-FM-176

November 24, 1967

PRELIMINARY EVALUATION OF THE POLYNOMIAL AND INTEGRATED MODES OF THE GENERALIZED ITERATOR FOR LOI TARGETING IN THE RTCC

By David K. Banner,
Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 67-FM-179

November 24, 1967

DESCRIPTION OF PRESENT AS-505/CSM-104/LM-4 MISSION

By David D. De Atkine
and
Alexander Woronow,
Rendezvous Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-181

November 24, 1967

AAP-1A TRAJECTORY DATA TO EVALUATE THE CAPABILITY FOR EARTH RESOURCES EXPERIMENTS

By Alexie H. Benney, Jr.,
Rendezvous Analysis Branch

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MSC INTERNAL NOTE NO. 67-FM-183

November 29, 1967

PERFORMANCE OF THE LUNAR MODULE ASCENT PROPULSION SYSTEM IN A BLOWDOWN MODE

By Arnold J. Loyd,

Guidance and Performance Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-184

November 28, 1967

AS-504/CSM-103/LM-3

MISSION PROFILE

By Harold L. Conway,

James D. Alexander, and

Francisco J. T. Leon-Guerrero

Rendezvous Analysis Branch

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MSC INTERNAL NOTE NO. 67-FM-185

November 30, 1967

NAVIGATION ERROR ANALYSES OF THE FIRST RENDEZVOUS SEQUENCE OF AS-205/101

By Jack H. Shreffler,

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 67-FM-189

December 8, 1967

MINIMUM ΔV REQUIRED TO RETURN TO EARTH FROM MOON-CENTERED ELLIPSES RESULTING FROM CSM RESCUE OF THE LM

By Lazarus Gonzales, Jr.,
Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 67-FM-190A

December 27, 1967

APOLLO 5 MISSION (AS-204/LM-1) SPACECRAFT DISPERSION ANALYSIS - SUPPLEMENT A

By R. Leroy McHenry,

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO.67-FM-191

December 11, 1967

AAP-1A PRELIMINARY LAUNCH ABORT ANALYSIS

By Bryson M. Pursell,
Flight Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-195

December 29, 1967

APOLLO 5 MISSION (AS-204/LM-1) SPACECRAFT OPERATIONAL TRAJECTORY

VOLUME I - MISSION DESCRIPTION

By Edwin G. Dupnick
and
Veit Hanssen,
Lunar Landing Branch

(This revision supersedes Volume I of MSC Internal Note 67-FM-5 dated April 1, 1967)

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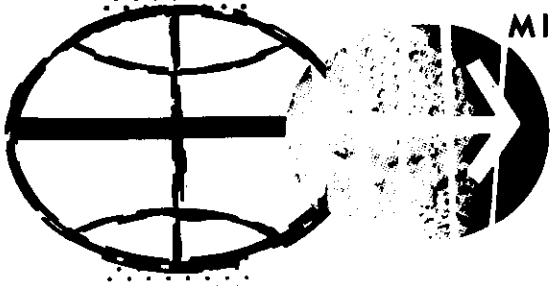
MSC INTERNAL NOTE NO. 67-FM-197

December 20, 1967

FINITE AND IMPULSIVE BURN SIMULATIONS OF FIXED-ATTITUDE TRANSLUNAR INJECTION ABORTS

By Charles E. Foggatt,
Flight Analysis Branch



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MSC INTERNAL NOTE NO. 67-FM-198

December 15, 1967

AS-503A/AS-504A REQUIREMENTS FOR THE RTCC: REENTRY PHASE

By James W. Tolin, Jr.,
Oliver Hill,
Jon C. Harpold,
James C. Adams,
and
Joseph E. Rogers,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note 67-FM-57
dated July 3, 1967.)
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 67-FM-199

December 15, 1967

AS-503/504 REQUIREMENTS FOR THE RTCC: THE RETURN-TO-EARTH ABORT PROCESSOR VOLUME I - EARTH-CENTERED LOGIC

By Robert S. Davis,
Lunar Mission Analysis Branch,
and
W. R. Lee,
TRW Systems

(This document supersedes MSC Internal Note 67-FM-134 dated September 25, 1967.)

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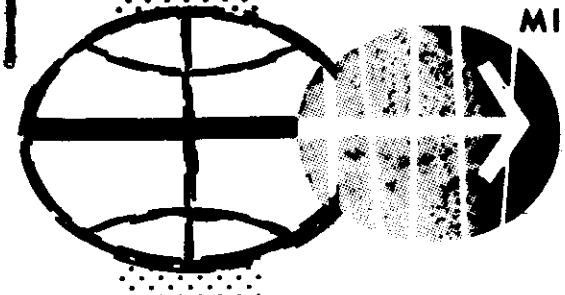

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MSC INTERNAL NOTE NO. 67-FM-200

December 27, 1967

THE MSC CSM ELECTRICAL POWER SUBSYSTEM PROGRAM

By Roy E. Stokes,
Guidance and Performance Branch

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MSC INTERNAL NOTE NO. 67-FM-201

December 27, 1967

SPACECRAFT OPERATIONAL ABORT AND ALTERNATE MISSION PLAN FOR AS-204/LM-1 VOLUME II - ALTERNATE MISSION

By Edwin G. Dupnick
and
Stanton A. Glantz,
Lunar Landing Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-202

December 27, 1967

A NON-ITERATIVE METHOD FOR THE DETERMINATION OF ACTUAL APOGEE AND PERIGEE RADII

By Wesley D. Ratcliff
Rendezvous Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-203

December 27, 1967

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REVISED LM DESCENT AND ASCENT ΔV BUDGETS FOR THE LUNAR LANDING MISSION

By Floyd V. Bennett,
Lunar Landing Branch

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MSC INTERNAL NOTE NO. 67-FM-214

December 28, 1967

SELECTION OF LUNAR LANDING SITES BASED ON PERFORMANCE AND OPERATIONAL CONSIDERATIONS

By James R. Elk
and
Quentin A. Holmes,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-1

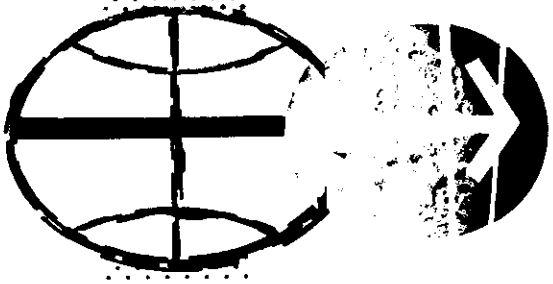
January 2, 1968

APOLLO 5 MISSION (AS-204/LM-1) SPACECRAFT OPERATIONAL TRAJECTORY VOLUME IV - CONSUMABLES ANALYSIS

By Consumables Analysis Section,

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-2

February 1, 1968

RTCC REQUIREMENTS FOR MISSION G: LANDING SITE DETERMINATION USING ONBOARD OBSERVATIONS

By Paul F. Flanagan,
Mathematical Physics Branch,
and George A. Austin,
Analytical Mechanics Associates, Inc.

(This document supersedes pp. 103-120 and pp. 223-236 of MSC Internal Note No. 67-FM-51 dated May 31, 1967.)

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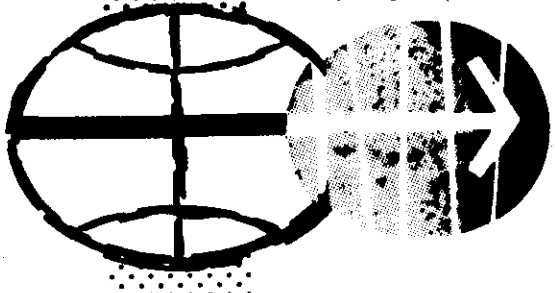

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MSC INTERNAL NOTE NO. 68-FM-3

January 4, 1968

LOGIC FOR THE REAL-TIME THRUST MODEL

By Ernest M. Fridge
and Dennis M. Braley
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-4

January 8, 1968

TRAJECTORY INFORMATION FOR INITIAL PLANNING OF TERMINAL PHASE OF COELLIPTIC SEQUENCE RENDEZVOUS IN LUNAR ORBIT

By James D. Alexander
and Mary T. Alexander,
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-5

January 5, 1968

LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF THE LUNAR MODULE LAUNCH WINDOW AND RECOMMENDED LIFT-OFF TIME

By W. A. Sullivan,

Orbital Mission Analysis Branch

(This revision supersedes Internal Note 67-FM-1 dated January 6, 1967.)

MISSION PLANNING AND ANALYSIS DIVISION

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FOR

MSC INTERNAL NOTE 68-FM-5 DATED JANUARY 5, 1968

LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF THE

LUNAR MODULE LAUNCH WINDOW AND RECOMMENDED LIFT-OFF TIME

By W. A. Sullivan

Change 2

September 18, 1968

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

Page 1 of 4
(with enclosures)

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1. Replace pages 16, 18, and 25.

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MSC INTERNAL NOTE NO. 68-FM-6

JANUARY 8, 1968

MISSION B-1/LM-1 (APOLLO 5) SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

MSC Task Monitor
M.L. Williamson

MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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For

NASA-MSC Internal Note 68-FM-6, dated January 8, 1968

Mission B-1/LM-1 (Apollo 5)

Separation and Recontact

Analysis

Summary Document

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

Change 1
January 12, 1968

R. E. McAdams, Head
Flight Studies Section
NASA/MSC

M. P. Meyers, Task Manager
Analytic Mechanics Section
TRW Systems Group

C. R. Hicks, Jr., Chief
Flight Analysis Branch
NASA/MSC

D. M. Austgen, Manager
Mission Simulation Department
TRW Systems Group

J. P. Mayer, Chief
Mission Planning and Analysis Division
NASA/MSC

C. R. Coates, Assistant Project Manager
Mission Trajectory Control Program
TRW Systems Group

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NOTE:
1. The Introduction has been updated. (Page 1)
2. The summary table has been updated. (Page 3)
3. Section 4.1.3 has been added. (Page 6)
4. A reference has been added. (Page 10)

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MSC INTERNAL NOTE NO. 68-FM- 7

January 3, 1968

MISSION B-1/LM-1 (APOLLO 5) SEPARATION AND RECONTACT ANALYSIS

S-IVB/LM-1 SEPARATION

VOLUME I

PRA/ATCA CONTROL

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

MSC Task Monitor
M. L. Williamson

MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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MSC INTERNAL NOTE NO. 68-FM-8

January 8, 1968

A PRELIMINARY MONTE CARLO DISPERSION ANALYSIS ON THE LUNAR LANDING MISSION

By Joe W. Nolley,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO.67-FM-166

November 6, 1967

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THE EFFECT OF INJECTION GUIDANCE SYSTEM ERRORS ON MIDCOURSE ΔV FOR MANNED MARS AND VENUS FLYBY MISSIONS

By Thomas B. Murtagh and
Stewart F. McAdoo, Jr.
Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 68-FM-21, DATED FEBRUARY 10, 1967

LOGIC CHANGES TO THE TWO-IMPULSE

PROCESSOR FOR PROJECT APOLLO

By Jerome A. Bell

Change 1

April 1, 1968

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

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1. Replace pages iii, 5, and 29.

2. Add pages 23, 24, 25, 26, 27, and 28.

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MSC INTERNAL NOTE NO. 68-FM-22

January 23, 1968

THE EFFECTS OF WIND FORCES ON A THRUSTING LAUNCH VEHICLE AND LAUNCH ESCAPE SYSTEM FOR APOLLO MODE I ABORTS

By Donald L. Dietrick,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-16

January 18, 1968

PREFLIGHT DATA FOR A LUNAR LANDING MISSION

VOLUME III- TRAJECTORY PARAMETER SUMMARIES FOR EACH LAUNCH DAY IN THE MONTHLY WINDOW

By Lunar Mission Design Section,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-17

JANUARY 18, 1968

NAVIGATIONAL CAPABILITIES OF THE SEXTANT AND RANGING DEVICE FOR CSM-ACTIVE RENDEZVOUS

By Jack H. Shreffler,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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FOR

MSC INTERNAL NOTE 68-FM-17, DATED JANUARY 18, 1968

NAVIGATIONAL CAPABILITIES OF THE SEXTANT AND RANGING DEVICE FOR CSM-ACTIVE RENDEZVOUS

By Jack H. Shreffler

Change 1

February 14, 1968

James C. McPherson, Chief
Mathematical Physics Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

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1. On page 2, under ASSUMPTIONS, (2) should read:

Bias on intervehicular measurements

0.0002 radians for each sextant angle
10 ft in range

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DATE: 5/22/70

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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

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NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See list below

DATE: 18 APR 1968

FROM : FM/Mission Planning and Analysis Division

68-FM73-163

SUBJECT: Change 1 to Logic and Equations for the RTCC Lunar Ascent Predictor

Reference: MSC Internal Note No. 68-FM-18, "Logic and Equations for the RTCC Lunar Ascent Predictor," dated January 22, 1968.

Since the publication of the referenced document, an error in synchronizing state vectors is indicated due to large time tag differences. At the time of publication, it was thought that the time tag difference was less than two seconds, so a short free fall method was adequate. The time difference between the state vector is now thought to be more like four to six seconds and, therefore, the present free fall scheme couldn't handle it.

The free fall logic to synchronize state vectors has been removed and the present plans are to use an interpolation scheme to do the synchronization. However, this will not be included in the predictor logic.

The attached flow charts reflect the updated predictor logic. The page numbers are the same as in the original document.

Marlowe D. Cassetti, Chief
Guidance and Performance Branch

John P. Mayer, Chief
Mission Planning and
Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., ~~Chief~~
Flight Software Branch

Enclosure

Addressees: (See attached list)

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MSC INTERNAL NOTE NO. 68-FM-19

January 22,1968

MPAD VERIFICATION OF APOLLO 5 (AS-204/LM-1) FLIGHT MISSION RULES

By Mission Planning And Analysis Division

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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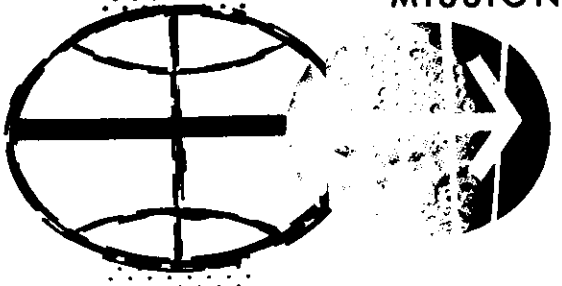
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-20

January 22, 1968

STATUS REPORT ON THE LUNAR MISSION ENTRY MONITORING AND BACKUP MODE DEVELOPMENT

By Jon C. Harpold
and
James C. Adams,
Lunar Mission Analysis Branch



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MSC INTERNAL NOTE NO. 68-FM-14

January 16, 1968

APOLLO MISSION C (AS-205/CSM-101) SPACECRAFT REFERENCE TRAJECTORY

VOLUME II - TRAJECTORY LISTING

By David J. Griffith and Jay W. Terry,

and

David W. Heath,

Lunar Mission Analysis Branch

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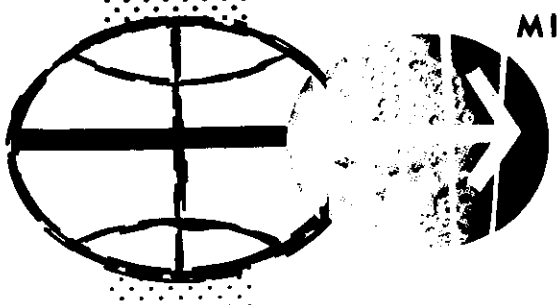
MSC INTERNAL NOTE NO. 68-FM-13

January 16, 1968

APOLLO MISSION C (AS-205/CSM-101) SPACECRAFT REFERENCE TRAJECTORY

VOLUME I - MISSION DESCRIPTION

By David J. Griffith and Jay W. Terry,
Orbital Mission Analysis Branch,
and
David W. Heath,
Lunar Mission Analysis Branch



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MSC INTERNAL NOTE NO. 68-FM-11

January 9, 1968

APOLLO 5 MISSION (AS-204/LM-1) SPACECRAFT OPERATIONAL TRAJECTORY VOLUME III - TRACKING AND ASPECT ANGLE DATA

By Edwin G. Dupnick and Veit Hanssen,
Lunar Landing Branch

(This revision supersedes Volume III of MSC Internal Note No. 67-FM-5 dated April 1, 1967)

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MSC INTERNAL NOTE NO. 68-FM-12

January 15, 1968

LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF A SATELLITE EPHEMERIS ABOUT THE MOON IN TERMS OF A SPECIALIZED POTENTIAL

By Edward J. Kenyon,
William A. Sullivan,
and William A. Reini,
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE HISTORY FOR 68-FM-12

Change No.	Date	Description
1	5/12/69	The following logic changes have been made so that the Lunar Analytic Ephemeris Generator (LAEG) will accept the R2 potential model. 1. Terms for J_{30}, J_{40} and J_{31} have been added to the equation for the computation of the mean motion, 2. The terms needed for the J_{40} effect on the secular rates of the node and the argument of perigee have been added. 3. The inclination function Flmp and the eccentricity function Flpq have been expanded for R2 potential 4. The computation of the constants of integration g_o, e_o, $\sin I_o$, and Ω_o have been changed to reflect the long term periodic effects of R2 These changes resulted in the following changes to the document: Pages — Changes 13 — The J_{30}, J_{40}, and J_{31} terms are added to the O_A equation. 14 — The J_{40} term are added to the $\dot{\omega}$ and $\dot{\Omega}$ equations 14A,B,C — The inclination function Flmp is expanded for J_{30}, J_{40}, and J_{31} 15A,B, and 16 — The eccentricity function glpq is expanded for J_{30} and J_{40} 45,46 — The method of computing e_o, g_o, $\sin I_o$ and Ω_o is shown

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DATE: 5/22/70

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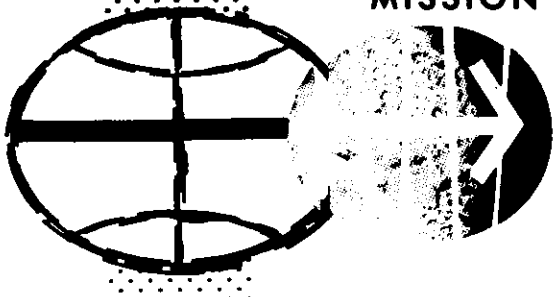
MSC INTERNAL NOTE NO.68-FM-9

January 9, 1968

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY - APOLLO 5 FLIGHT ANNEX

By Larry D. Davis
and
Ronald D. Davis,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-10

January 10, 1968

THE REAL-TIME AUXILIARY COMPUTING FACILITY LV-204/LM-01 (APOLLO 5) OPERATIONAL SUPPORT TEAM HANDBOOK

By Mission Operations Section
TRW Systems Group

MSC Subtask Monitor
L. D. Davis

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-21

January 23, 1968

THE CALCULATION OF TRAJECTORIES BY THE EMPIRICAL SIMULATION OF RESTRICTED STATE VECTORS

By Francis Johnson, Jr.,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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UNITED STATES GOVERNMENT

Memorandum

TO : See list below

DATE: 25 JUL 1968

68-FM61-230

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Transmittal of detailed programming requirements

The enclosed changes to MSC Internal Note No. 68-FM-23 present additional detailed requirements for the real-time computer program to be employed in support of the Apollo missions beginning with the lunar landing mission. The changes are necessary for the computation of two additional maneuver sequences. These change sheets should be inserted into MSC Internal Note No. 68-FM-23.

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:
IBM/J. Bednarcyk (5)
H. Norman
R. Sogard
J. Stein
A. Anicetti
S. James
FS/L. Dunseith
J. Stokes (3)
L. Dungan
FC/C. Charlesworth
FM/J. P. Mayer
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MSC INTERNAL NOTE NO. 68-FM-24

January 30,1968

MINIMUM VELOCITY INCREMENT SINGLE-IMPULSE PROPULSIVE-GRAVITY TURN WITH CONSTRAINTS ON THE PERIAPSIS RADIUS

By Benjamine J. Garland,
Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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MSC INTERNAL NOTE NO. 68-FM-25

January 30, 1968

METHODS FOR DETERMINING THE ORBITAL TRANSFER REQUIREMENTS FOR NEAR-EARTH ORBITS

By Samuel L. Miller
and
David J. Griffith,
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-26

January 30, 1968

APOLLO MISSION C REQUIREMENTS FOR THE REAL-TIME PROGRAM REENTRY PHASE

By James W. Tolin, Jr.
and Oliver Hill,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-27

February 1, 1968

RTCC REQUIREMENTS FOR MISSION G: RETURN-TO-EARTH ABORT CONIC SUBPROCESSOR FOR MOON-CENTERED ABORTS

By D. M. Gafford,
F. M. Northcutt,
and J. D. Monroe,
TRW Systems

(This document supersedes MSC Internal Note No. 67-FM-80 dated June 19, 1967.)

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TO : See List Below

DATE: 29 MAR 1968
68-FM54-116

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT: Change 1 to the RTCC requirements for the return-to-earth abort conic subprocessors for moon-centered aborts

The enclosed contains corrections and additions to MSC Internal Note No. 68-FM-27.

M. P. Frank

APPROVED BY:

John P. Mayer, Chief
Mission Planning and
Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

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Mission Planning & Analysis Division

TO : See List Below

DATE: 24 MAY 1968

68-FM54 195

FROM : FM5/Lunar Mission Analysis Branch

SUBJECT: Change 2 to the RTCC requirements for the return-to-earth abort conic subprocessor for moon-centered aborts

The enclosed contains corrections and additions to MSC Internal Note No. 68-FM-27.

Ronald L. Berry

Ronald L. Berry, Acting Chief
Lunar Mission Analysis Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

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TO : See List Below

DATE: 2 AUG 1968
68-FM54-262

FROM : FM5/Lunar Mission Analysis Branch

SUBJECT: Change 3 to the RTCC requirements for the return-to-earth abort conic subprocessor for moon-reference aborts

Reference is made to MSC Internal Note No. 68-FM-27, "RTCC requirements for Mission "G": Return-to-Earth abort conic subprocessor for moon-centered aborts", by D. M. Gafford, F. M. Northcutt, and J. D. Monroe.

The enclosed document is change 3 to the referenced internal note. These changes correct logic deficiencies and modify the logic to accommodate the reentry curve fits.

The logic changes presented herein only apply to the Lunar Landing Program (LLP).

Ronald L. Berry, Acting Chief
Lunar Mission Analysis Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees: (See attached list)

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TO : See attached list

DATE: Dec. 16, 1969

FROM : FM5/Chief, Lunar Mission Analysis Branch 69-FM54-315

SUBJECT: RTCC requirements for H3 (Apollo 14) - Changes to moon-centered return-to-earth processor

The attached change sheets define RTCC program logic changes for the H3 system. These include:

1. Inclination control mode
2. New moon reference conic package
3. Vector offset technique
4. Overlapped conic

for Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief,
Flight Software Branch

Enclosures

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NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: JAN 3 0 1969

69-FM54-11

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT: Modification to the Jacobi correction logic in the moon-centered conic abort subprocessor of the return-to-earth abort processor

Reference is made to MSC internal note No. 68-FM-27, "RTCC Requirements for Mission "G": Return-to- Earth abort conic subprocessor for moon-centered aborts", by D. M. Gafford, F. M. Northcutt, and J. D. Monroe, and dated February 1, 1968.

The enclosed document represents the fourth change to the above referenced document. The logic changes defined and discussed herein improve the accuracy of the Jacobi correction for some abort situations. These changes represent G mission program logic requirements.

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

cc: (See attached list)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-28

February 1, 1968

RTCC REQUIREMENTS FOR MISSIONS E AND G: TRANSLUNAR INJECTION PROCESSOR

By David S. Scheffman,
Jerome D. Yencharis,
and Brody O. Mc Caffety,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-90 dated June 29, 1967.)

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MSC INTERNAL NOTE NO. 68-FM-31

February 29, 1968

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY LV-502/CSM-020 FLIGHT ANNEX

By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
TRW Systems Group

MSC Subtask Monitor
S. D. Holzaepfel

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MSC INTERNAL NOTE NO. 68-FM-32

February 26, 1968

RTCC REQUIREMENTS FOR MISSION G: FIRST-GUESS LOGIC FOR THE TLI PROCESSOR

By Francis Johnson, Jr. and Thomas J. Linbeck
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: 27 MAY 1968

68-FM52-197

FROM : FM5/Lunar Mission Analysis Branch

SUBJECT: Change 1 to the RTCC requirements for Mission G: First Guess Logic for the TLI Processor

The enclosed contains the corrections and additions to MSC Internal Note No. 68-FM-32.

Ronald L. Berry

Ronald L. Berry, Acting Chief
Lunar Mission Analysis Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees: (See attached list)

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MSC INTERNAL NOTE NO. 68-FM-33

February 1, 1968

RTCC REQUIREMENTS FOR MISSIONS E AND G: THE RETURN-TO-EARTH ABORT PROCESSOR VOLUME II - MOON-CENTERED LOGIC

By Robert S. Davis,
Lunar Mission Analysis Branch,
and D. W. Gafford,
TRW Systems

(This document supersedes MSC Internal Note No. 67-FM-199 dated December 15, 1967.)

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MSC INTERNAL NOTE NO. 68-FM-35

February 9, 1968

LOGIC FOR REAL-TIME COMPUTATION OF LUNAR CONCENTRIC RENDEZVOUS MANEUVERS

By Elric N. McHenry,
Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-20 dated January 31, 1967.)

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Memorandum

TO : See list below

DATE: 12 AUG 1968

68-FM61-263

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Transmittal of changes to detailed programming requirements

The enclosed flow chart changes are to MSC Internal Note No. 68-FM-35 which presented detailed requirements for the real-time computer program to be used in support of Apollo missions starting with the D mission. The changes are to the CSI iteration logic and are needed to stabilize the ΔV estimator whenever the pre-CSI trajectory is near circular.

for Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:
IBM/J. Bednarcyk (5)
H. Norman
R. Sogaard
J. Stein
A. Anicetti
S. James
FS5/J. Stokes (5)
L. Dungan

FC/C. Charlesworth
FM/J. P. Mayer
H. W. Tindall, Jr.
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UNITED STATES GOVERNMENT

Memorandum

TO : See list below

DATE: 25 OCT 1968

68-FM61-316

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Transmittal of changes to detailed programming requirements

The enclosed flow chart changes are to MSC Internal Note No. 68-FM-35 and represent logic requirements for the Apollo E mission RTCC computer program. The changes are needed for certain rescue situations which require CSM dwell maneuvers.

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:

IBM/J. Bednarcyk (5)
H. Norman
R. Sogaard
S. Stein
A. Anicetti
S. James
FS5/J. Stokes (5)
D. Dungan
FC/C. Charlesworth
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CHANGE HISTORY FOR 68-FM-35

Change no.	Date	Description
1	8/5/68	The CSI iteration logic was changed to constrain iteration estimates of ΔV_{CSI} so that the program would not fail due to a bad first guess from the ΔV estimator equations. All changes are to the flow chart of subroutine CORE. Page 43 is replaced and 43a is added. The pages contain logic to bound ΔV_{CSI}. Pages 51 and 54 have been modified to provide a stable prediction of CDH true anomaly to be used in the generation of the first ΔV_{CSI} guess.
2	10/11/68	The definition of the input flag I_θ is changed to allow phase angle definition control at TPI, not at the initial vector time. Adjusting the initial elements to give the desired sign on the initial phase angle is not an adequate control of the rendezvous solution whenever the rendezvous sequence requires several revolutions to complete. Also, the automatic recycle option of the program is deleted. Specifically, this involved the following: Page(s) — Changes 18 — I_θ definition changed 22 — Delete call to ADJUS 43a — Change to exit on iteration failure 64 — Change to exit on iteration failure 69 — Delete recycle logic 70 — Delete 72-76 — Delete 78 — Modify JOCSI to call PMISS 80-81 — Add I_θ logic to PMISS

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Mission Planning & Analysis Division

TO : See list below

DATE: SEP 11 1969

69-FM61-174

FROM : FM6/Chief, Orbital Mission Analysis Branch

SUBJECT: Transmittal of additions to detailed programming requirements

The enclosure constitutes change no. 4 to MSC Internal Note No. 68-FM-35. The changes and additions are logic changes to the Apollo 13 RTCC rendezvous targeting computations. They are applicable to post-CSI targeting and are required to provide RTCC capability to iterate on the CDH time which will hold TPI time fixed.

Edgar C. Lineberry

Edgar C. Lineberry

Approved by:

for John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:
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MSC INTERNAL NOTE NO. 68-FM-23

January 26, 1968

LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF THE LUNAR MODULE DESCENT PLANNING TABLE

By William A. Sullivan,

Orbital Mission Analysis Branch

(This revision supersedes MSC
Internal Note No. 67-FM-68 dated May 9, 1967)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-37

February 14, 1968

REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 5 MISSION REPORT

By Larry D. Davis,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
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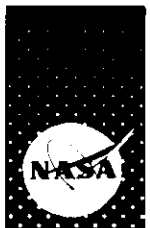

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-38

February 14, 1968

PREFLIGHT TRACKING DATA FOR THE LAUNCH PHASE OF A LUNAR MISSION

By Edward M. Jiongo,

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-39

February 14, 1968

A PRELIMINARY STUDY OF A LUNAR LANDING MISSION TO COPERNICUS

By Gus R. Babb, Jr.,

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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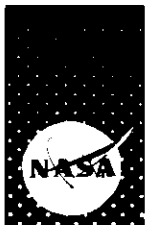


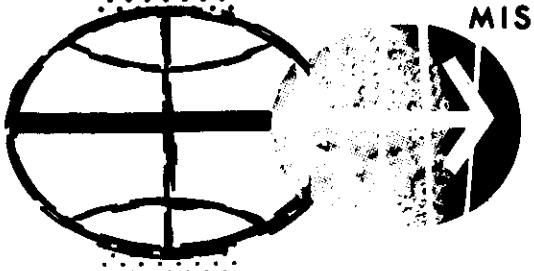
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-40

February 16,1968

VERIFICATION OF THE PROPAGATION CONTROL PACKAGE OF THE MPB ORBIT DETERMINATION PROGRAM

By Herbert A. Perkins,
Mathematical Physics Branch



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE NO. 68-FM-41

February 16,1968

PREFLIGHT DATA FOR A LUNAR LANDING MISSION

VOLUME II - MISSION PROFILE

By Lunar Mission Analysis Branch
and Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-43

February 18, 1968

ERRORS INCURRED WITH RTCC LUNAR ORBIT INSERTION LOGIC

By Roger H. Sanders,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 68-FM-44

February 16, 1968

DOPPLER OBSERVABLE MODELING FOR THE APOLLO REAL-TIME ORBIT DETERMINATION PROGRAM

By Howard G. de Vezin,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-45

February 16, 1968

MISSION A-2/CSM 020 (APOLLO 6) SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

MSC Task Monitor
M. L. Williamson

MISSION PLANNING AND ANALYSIS DIVISION
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For

NASA-MSC Internal Note 68-FM-45, dated February 16, 1968

Mission A-2/CSM 020 (Apollo 6)

Separation and Recontact

Analysis

Summary Document

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

Change 1
February 23, 1968

R. E. McAdams, Head
Flight Studies Section
NASA/MSC

M. P. Meyers, Task Manager
Analytic Mechanics Section
TRW Systems Group

C. R. Hicks, Jr., Chief
Flight Analysis Branch
NASA/MSC

D. M. Austgen, Manager
Mission Simulation Department
TRW Systems Group

J. P. Mayer, Chief
Mission Planning and Analysis Division
NASA/MSC

C. R. Coates, Assistant Project Manager
Mission Trajectory Control Program
TRW Systems Group

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NOTE:
1. The Table of Contents has been updated. (Page iv)
2. Lists of Illustrations and Tables have been added. (page iva)
3. The List of Nomenclature has been updated. (Page v)
4. The Introduction has been updated. (Page 1)

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NASA-MSC Internal Note 68-FM-45, dated February 16, 1968

Mission A-2/CSM 020 (Apollo 6)

Separation and Recontact

Analysis

Summary Document

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

Change 2
March 15, 1968

R. E. McAdams, Head
Flight Studies Section
NASA/MSC

M. P. Meyers, Task Manager
Analytic Mechanics Section
TRW Systems Group

for C. R. Hicks, Jr., Chief
Flight Analysis Branch
NASA/MSC

D. M. Austgen, Manager
Mission Simulation Department
TRW Systems Group

J. P. Mayer, Chief
Mission Planning and Analysis Division
NASA/MSC

for C. R. Coates, Assistant Project Manager
Mission Trajectory Control Program
TRW Systems Group

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3. The List of Nomenclature has been updated. (Page v)
4. The Introduction has been updated. (Page 1)

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MSC INTERNAL NOTE NO. 68-FM-46

February 18, 1968

FORMULATION OF RENDEZVOUS NAVIGATION PLANS FOR MISSIONS D, E, AND G

By Navigation Analysis Section
TRW Systems Group

MSC Task Monitor
P. T. Pixley

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE NO. 68-FM-47

February 21, 1968

CHARACTERISTIC VELOCITY REQUIRED FOR ORBITAL INSERTION AND TRANSEARTH INJECTION ON VENUS ORBITAL MISSIONS LAUNCHED IN 1975

By Stewart F. McAdoo, Jr. and John T. McNeely,
Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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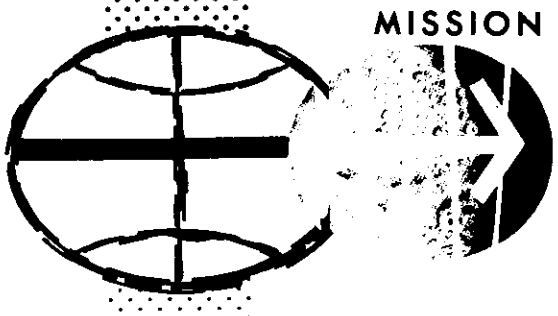
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-50

February 23, 1968

NAVIGATION AND GUIDANCE SYSTEMS PERFORMANCE FOR MANNED MISSIONS TO VENUS AND MARS BETWEEN 1972 AND 1980

By Flora B. Lowes
and
Thomas B. Murtagh,
Advanced Mission Design Branch



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MSC INTERNAL NOTE NO. 68-FM-52

February 23, 1968

RTCC REQUIREMENTS FOR MISSION G: LUNAR MODULE ATTITUDE DETERMINATION USING ONBOARD OBSERVATIONS

By B. F. Cockrell,
Mathematical Physics Branch

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UNITED STATES GOVERNMENT

Change Sheet, ~~Name~~ FM4
68 FM - 52

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

Memorandum

TO : See List Below

DATE: 17 APR 1968
68-FM47-127

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Change Sheet for MSC Internal Note 68-FM-52

1. Reference: MSC Internal Note 68-FM-52, "RTCC Requirements for Mission G: Lunar Module Attitude Determination Using Onboard Observations," by FM4/B. F. Cockrell, February 23, 1968.

2. This memo specifies revisions of the referenced document to incorporate the time tag offset for downlinked data, and to correct errors in the flow charts.

3. The time tagging of the RR data is done when the CDU's are read which is 5 to 10 milliseconds after the doppler count is completed; however, the observation set will be time tagged in the middle of the doppler count. For this reason an offset of about 50 milliseconds will be added.

4. The attached pages from the original report were changed to reflect the revisions to the convergence processor flow charts.

James C. McPherson, Chief
Mathematical Physics Branch

The Flight Software Branch consurs with the above recommendation and requests IBM to proceed accordingly.

James C. Stokes, Jr., Chief
Flight Software Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

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MSC INTERNAL NOTE NO. 68-FM-53

February 26, 1968

RTCC REQUIREMENTS FOR MISSIONS E, F, AND G: GREENWICH HOUR ANGLE FORMULATION FOR THE PREDICTOR

By Paul F. Flanagan,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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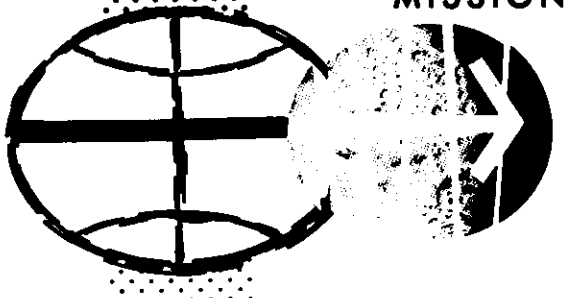
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-55

March 4, 1968

PREDICTED LAUNCH ABORT LANDING POINT DATA COMPUTED DURING APOLLO 4

By E. R. Hischke,
Flight Analysis Branch



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-57

March 29, 1968

MSC/MSFC LUNAR MISSION TARGETING EXERCISE

By Lunar Mission Design Section,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-59

MARCH 1, 1968

APOLLO 6 (A-2 OR AS-502/020) SPACECRAFT OPERATIONAL ALTERNATE MISSION PLAN

By Lunar Analysis Section
TRW Systems Group

MSC Task Monitor
W. J. Bennett

MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-36

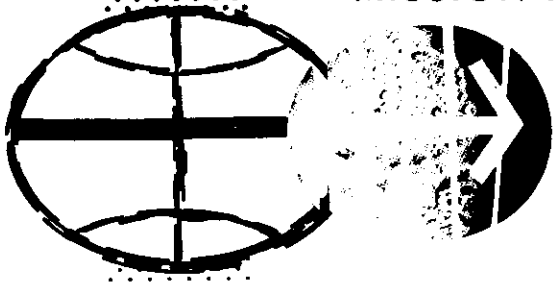
February 14, 1968

REENTRY ERROR ANALYSIS FOR THE APOLLO LUNAR LANDING MISSION

By Claude A. Graves,

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-62

March 13, 1968

APOLLO 6
(A-2 OR AS-502/CSM-020) SPACECRAFT OPERATIONAL TRAJECTORY
VOLUME I - MISSION PROFILE

By William J. Bennett and Ronny H. Moore,
Orbital Mission Analysis Branch,
and Jon C. Harpold,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-63

March 13, 1968

APOLLO 6
(A-2 OR AS-502/CSM-020)
SPACECRAFT OPERATIONAL TRAJECTORY
VOLUME II - TRAJECTORY LISTING

By William J. Bennett and Ronny H. Moore,
Orbital Mission Analysis Branch,
and Jon C. Harpold, Lunar Mission Analysis Branch

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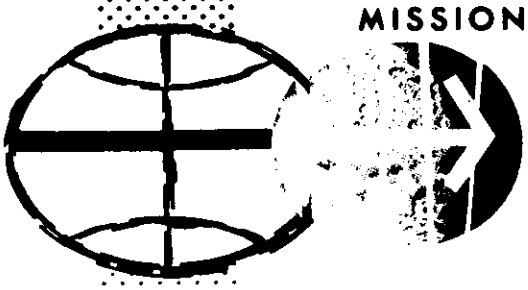
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-64

March 8, 1968

MATCHED-CONIC SOLUTIONS TO ROUND-TRIP INTERPLANETARY TRAJECTORY PROBLEMS THAT INSURE STATE VECTOR CONTINUITY AT ALL BOUNDARIES

By Victor R. Bond,
Advanced Mission Design Branch



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MSC INTERNAL NOTE NO. 68-FM-65

March 6, 1968

APOLLO 6 (AS-502/CSM-020) SPACECRAFT OPERATIONAL TRAJECTORY VOLUME IV - CONSUMABLES ANALYSIS

By Consumables Analysis Section,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-66

March 11, 1968

RTCC REQUIREMENTS FOR MISSIONS E, F, AND G: PREFLIGHT INFORMATION

By Rocky D. Duncan,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-68

March 8, 1968

RTCC REQUIREMENTS FOR MISSION G: SELECTING AND VERIFYING USBS DOPPLER DATA SOURCES DURING LM ASCENT AND DESCENT

By Alan D. Wylie,
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-30 dated February 1, 1968.)

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Memorandum

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Mission Planning & Analysis Division

TO : See List Below

DATE: 13 MAR 1968

68-FM51-97

FROM : FM5/Lunar Mission Analysis Branch

SUBJECT: RTCC Requirements for G Mission - Earth Orbit Insertion Computation during Pre-launch Phase

The enclosed MSC Internal Note No. 68-FM-69, defines the RTCC program logic necessary to compute the earth orbit insertion state for a given launch azimuth. The formulation is necessary in order to provide a mission planning capability in the pre-launch phase.

M. P. Frank, Chief
Lunar Mission Analysis Branch

APPROVED BY:

John P. Mayer, Chief
Mission Planning and
Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees: (See attached list)

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DATE: 5/22/70

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MSC INTERNAL NOTE NO. 68-FM-70

April 1, 1968

MANNED EXPLORATION OF MARS: A MINIMUM-ENERGY MISSION PLAN FOR MAXIMUM SCIENTIFIC RETURN

By Jack Funk, James J. Taylor,

Joseph R. Thibodeau III,

Flora B. Lowes, and John T. McNeely,

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE NO. 68-FM-71

March 18, 1968

APOLLO MISSION E (AS-504/CSM-104/LM-4) SPACECRAFT REFERENCE TRAJECTORY VOLUME II- TRAJECTORY LISTING

By David D. DeAtkine and Alexander Woronow,
Orbital Mission Analysis Branch,
and
Oliver Hill,
Lunar Mission Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-73

March 22, 1968

COMPARISON OF LM PGNCS AND AGS ORBIT INSERTION GUIDANCE LOGIC AND PROCEDURES

By Joe D. Payne,

Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-74

March 20, 1968

LM POWERED ASCENT TRAJECTORY FOR THE APOLLO LUNAR LANDING MISSION

By Joe D. Payne, William C. Lamey,

and Burl G. Kirkland,

Lunar Landing Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE NO. 68-FM-75

March 15, 1968

SPACECRAFT DISPERSION ANALYSIS FOR APOLLO 6 (A-2 OR AS-502/CSM-020)

By John T. Parker,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-61

March 5, 1968

APOLLO 6 (AS-502/CSM-020/LTA-2R) SPACECRAFT OPERATIONAL TRAJECTORY VOLUME III - TRACKING TIME HISTORY

By William J. Bennett and Ronny H. Moore,
Orbital Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-77

March 8, 1968

LAUNCH PHASE ABORT ANALYSIS FOR A 50-DEGREE ORBITAL INCLINATION TRAJECTORY

By Spaceflight Operations Department
TRW Systems Group

MSC Task Monitor
B. D. Weber

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MSC INTERNAL NOTE NOTE NO. 68-FM-78

March 29, 1968

LM POWERED DESCENT TRAJECTORY FOR THE APOLLO LUNAR LANDING MISSION

By James H. Alphin,
Billy G. Taylor, and Burl G. Kirkland,
Lunar Landing Branch

(This document supersedes MSC Internal Note No. 67-FM-117 dated August 15, 1967.)

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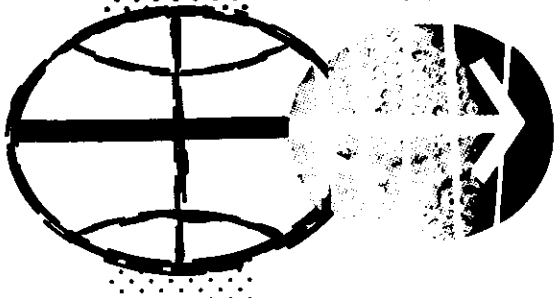

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE NO. 68-FM-79

April 12, 1968

MATHEMATICAL MODEL FOR THE LM LUNAR DESCENT HYBRID SIMULATION

By Willis M. Bolt, Gilbert L. Carman,
Charles R. Halliman, and Richard J. Labrecque,
Lunar Landing Branch

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MSC INTERNAL NOTE NO. 68-FM-80

March 26, 1968

GENERAL EXPLANATIONS OF NCC/NSR AND CSI/CDH COELLIPTIC SEQUENCE RENDEZVOUS TECHNIQUES

By James D. Alexander,
Orbital Mission Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-81

March 18, 1968

THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 6 (A-2/CSM-020) OPERATIONAL SUPPORT TEAM HANDBOOK

By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
TRW Systems Group

MSC Subtask Monitor
S. D. Holzaepfel

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MSC INTERNAL NOTE NO. 68-FM-82

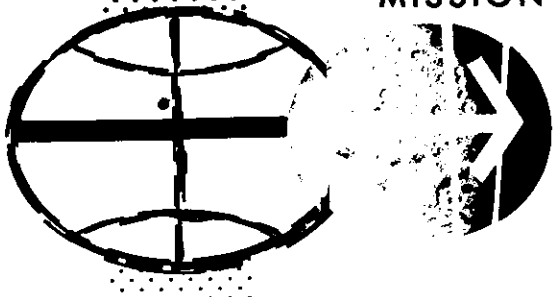
March 29, 1968

COMPARISON OF VENUS SWINGBY AND MINIMUM-ENERGY TECHNIQUES FOR MANNED MARS ORBITING MISSIONS

By James J. Taylor,

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-83

March 29, 1968

COMPARISON OF THE SENSITIVITY OF LAMBERT AND EXTERNAL ΔV GUIDANCES TO DISPERSIONS IN THE LOI BURNS OF MISSIONS F AND G

By Robert F. Wiley,

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-84

APRIL 21, 1968

FEASIBILITY OF MANUAL COMPLETION OF A LOI BURN VOLUME II- BMAG DRIFT ABOUT THE PITCH AXIS

By Alexander H. Treadway
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-86

April 10, 1968

RADAR DATA FOR CHOOSING PASSES TO SATISFY THE MISSION C (AS-205/CSM-101) RENDEZVOUS RADAR TEST OBJECTIVE

By Samuel L. Miller and David J. Griffith,
Orbital Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-87

April 3, 1968

MPAD VERIFICATION OF APOLLO 6 (A-2/CSM-020) FLIGHT MISSION RULES

By Mission Planning And Analysis Division

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-90

March 27, 1968

REENTRY POSTFLIGHT TRAJECTORY RECONSTRUCTION AND GUIDANCE EVALUATION FOR AS-501 (CSM-017)

By Flight Analysis Section,
TRW Systems

MSC Task Monitor
Jon Harpold

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-91

May 27, 1968

VERIFICATION OF THE KALMAN FILTER EQUATIONS USED IN THE LM AGS

By Richard E. Eckelkamp and Troy J. Blucker,
Mathematical Physics Branch,
and
Samuel Pines,
Analytical Mechanics Associates, Inc.

MISSION PLANNING AND ANALYSIS DIVISION

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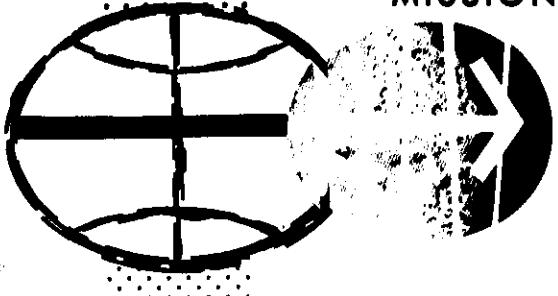
MSC INTERNAL NOTE NO. 68-FM-94

April 15, 1968

APOLLO MISSION D (AS-503/CSM-103/LM-3) SPACECRAFT REFERENCE TRAJECTORY VOLUME II - TRAJECTORY LISTING

By Harold L. Conway, Harold O. Spurlin,
and Robert S. Merriam,
Orbital Mission Analysis Branch,
and
Clair Calvin,
TRW Systems Group



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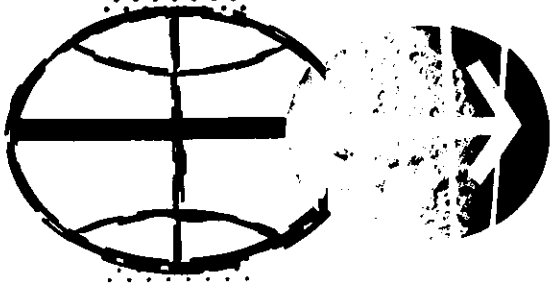
MSC INTERNAL NOTE NO. 68-FM-96

April 17, 1968

APOLLO MISSION C (AS-205/CSM-101) SPACECRAFT REFERENCE TRAJECTORY VOLUME IV - CONSUMABLES ANALYSIS

By Consumables Analysis Section,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-97

April 18, 1968

COMMUNICATION BLACKOUT REGIONS FOR APOLLO LUNAR MISSION REENTRIES

By John Burton and Nicholas W. Kirincich,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 66-FM-142 dated November 25, 1966.)

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MSC INTERNAL NOTE NO. 68-FM-76

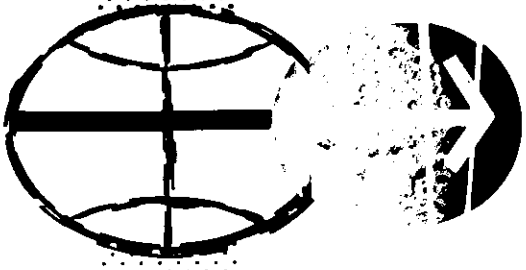
March 21, 1968

APOLLO 6 (A-2 OR AS-502/020) OPERATIONAL MODE I LAUNCH ESCAPE VEHICLE ABORT PLAN

By Dallas G. Ives and Samuel R. Newman,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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TO : See List Below

DATE: DEC 2 1968

68-FM47-451

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Current Formulation Revisions in the RTCC Ground Navigation Program

1. Reference: MSC Internal Note No. 68-FM-100, "Basic Equations and Logic for the Real-Time Ground Navigation Program for the Apollo Lunar Landing Mission," FM4/E. R. Schiesser, R. T. Savely, H. G. deVezin, M. J. Oles, April 15, 1968.

2. The purpose of this memorandum is to present changes recommended for the referenced document. The changes involve correcting the equations used for the local vertical corrections and the equations used to transform polar X, Y, Z topocentric coordinates to the earth-centered midnight-prior-to-launch coordinate system for the starter module of the ground navigation program, and the logic used to mechanize the KT PBI option of modifying the state covariance matrix.

3. In the process of correcting the observations for local vertical, the deflections of the local vertical in the direction of longitude and latitude ($\Delta\lambda$ and $\Delta\varphi$, respectively) must be used. The RTCC uses values of $\Delta\lambda$ and $\Delta\varphi$ found in the Goddard Directory of Tracking Station Locations. Hence, any set of equations used for the local vertical corrections should be derived from deflection definitions that are consistent with the deflection definitions in the Goddard Directory of Tracking Station Locations.

4. Investigation of the pertinent equations as they stand has revealed that they should be adjusted in order to achieve the above-mentioned consistency.

5. In the starter module of the low-speed ground orbit determination program (reference), topocentric range and angle observations are processed to obtain earth-centered position vectors referenced to the Greenwich midnight-prior-to-launch (GMPL) coordinate system. The computations made in processing the polar mount observations (hour angle and declination) differ from that for the other radar mount observations in that they are measured in a unique coordinate system (see reference, p. 69). The equations are being corrected in the reference to convert the topocentric position vectors of the polar mount tracking stations to the same topocentric reference as for all other radar mounts. The

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1. Type of Document: Change sheet to Internal Note

2. Identification: CB-FM-100 dated April 15, 1968

Page 1 of 1 Pages

TO:

3. FROM:
Division: Mission Planning and Analysis
Branch: Mathematical Physics Branch
Section:

4. Title or Subject: BASIC EQUATIONS AND LOGIC FOR THE REAL-TIME GROUND NAVIGATION PROGRAM FOR THE APOLLO LUNAR LANDING MISSION

Date of Paper: April 4, 1969

5. Author(s): Emil R. Schiesser, Howard C. deVezin, Robert T. Savely, and Michael J. Oles

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MSC INTERNAL NOTE NO. 68-FM-101

April 19, 1968

PREDICTED LAUNCH ABORT LANDING DATA COMPUTED DURING APOLLO 6

By E.R. Hischke,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-102

APRIL 24, 1968

RTCC REQUIREMENTS FOR MISSIONS D, E AND F: REENTRY PHASE

By James W. Tolin, Jr., Grover D. Fulkerson,
Jon C. Harpold, James C. Adams,
and Joseph E. Rogers,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-198 dated December 15, 1967.)

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Change no.	Date	Description
1	5/21/68	Pen-and-ink change to correct Constant and Value of VMIN

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MSC INTERNAL NOTE NO. 68-FM-103

APRIL 19, 1968

APOLLO MISSION D-a/CSM-103/LM-3 REVISED SPACECRAFT REFERENCE TRAJECTORY VOLUME I

BY ORBITAL ANALYSIS SECTION
TRW Systems Group

MSC Task Monitor
J.D. Alexander

MISSION PLANNING AND ANALYSIS DIVISION
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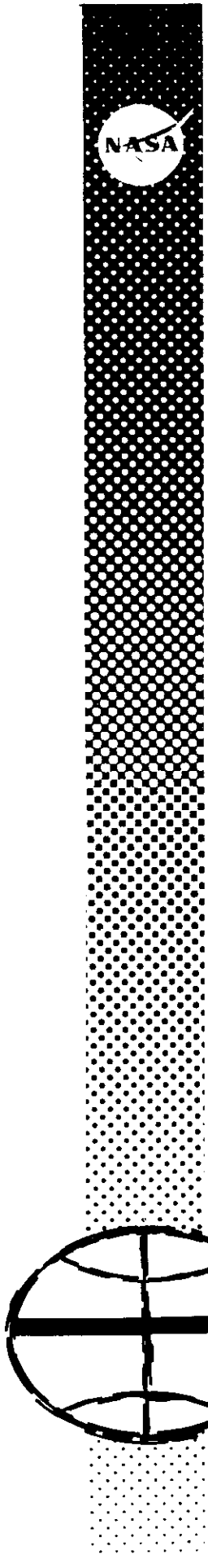

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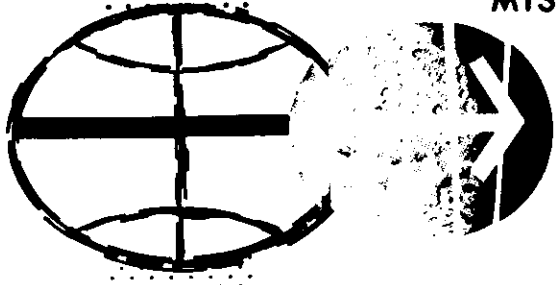
MSC INTERNAL NOTE NO. 68-FM-105

April 30, 1968

RTCC REQUIREMENTS FOR MISSION G: SELECTING AND VERIFYING USBS DOPPLER DATA SOURCES DURING LM ASCENT AND DESCENT

By Alan D. Wylie,
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-68 dated March 8, 1968.)



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CHANGE SHEET

FOR

MSC INTERNAL NOTE 68-FM-105 DATED APRIL 30, 1968

RTCC REQUIREMENTS FOR MISSION G:

SELECTING AND VERIFYING USBS DOPPLER DATA

SOURCES DURING LM ASCENT AND DESCENT

By Alan D. Wylie

Change 1

December 12, 1969

James C. McPherson, Chief
Mathematical Physics Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

Page 1 of 7
(with enclosures)

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacements, have been inserted, place this CHANGE SHEET between the cover and title page and write on the cover "CHANGE 1 inserted".

1. Replace pages 33, 40, 42, and 47.

2. Add pages 46A and 46B.

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Memorandum

TO : See List Below

DATE: JAN 7
69-FM47-416

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Incorporating NOUN 69 into the line-of-sight MSFN range rate residual processor for Apollo 14

1. References:

a. MSC Internal Note No. 68-FM-105, "RTCC Requirements for Mission G: Selecting and Verifying USBS Doppler Data Sources during LM Ascent and Descent," FM4/A. D. Wylie, April 30, 1968.

b. MSC Internal Note No. 68-FM-100, "Lunar Mission Requirements for the RTCC Ground Orbit Determination Program," FM4/E. R. Schiesser, R. T. Savely, H. G. deVezin, M. J. Oles, April 15, 1968.

c. MSC Memorandum No. 69-FM47-408, "Incorporating NOUN 69 into the line-of-sight MSFN range rate residual processor for Apollo 14," FM4/A. D. Wylie, December 17, 1969.

2. This memorandum presents recommended changes to the RTCC requirements of reference a for Apollo 14. These changes allow the RTCC high-speed MSFN processor to determine the downrange position error of the PDI initialization vector during the free flight phase prior to PDI. The formulation was obtained from reference b and merged into the existing logic of the high-speed MSFN program.

3. The formulation in this memorandum supersedes the formulation presented in reference c. It was discovered that formulation was necessary which related the downtrack error to the inertial velocity of the LM in order to determine the correct value for NOUN 69. All formulation requirements for the NOUN 69 procedures are included in the attachment.

Emil R. Schiesser
Assistant Chief
Mathematical Physics Branch

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DATE: 5/22/70

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MSC INTERNAL NOTE NO. 68-FM-106

May 1, 1968

APOLLO CSM AND LM ONBOARD NAVIGATION SYSTEM CONSTRAINTS

By T. J. Blucker,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-107

May 1, 1968

RTCC REQUIREMENTS FOR MISSION D AND SUBSEQUENT MISSIONS: LOGIC FOR THE MISSION PLANNING TABLE

By Ernest M. Fridge,

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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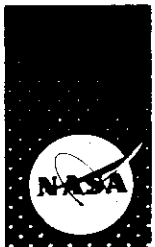

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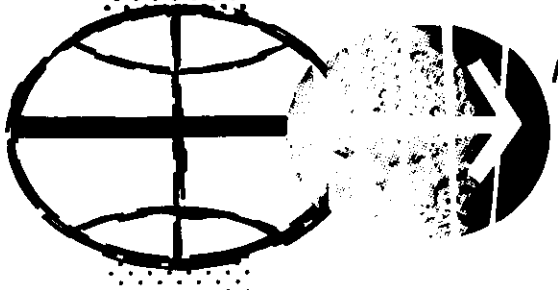
MSC INTERNAL NOTE NO. 68-FM-108

April 15, 1968

APOLLO MISSION D: AS-503/CSM-103/LM-3 SPACECRAFT PRELIMINARY ALTERNATE MISSION STUDIES

By Mission Analysis Laboratory
TRW Systems Group

MSC Task Monitors
Cathy Osgood
Stanton Glantz



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MSC INTERNAL NOTE NO. 68-FM-109

May 6, 1968

MISSION G ELECTRICAL POWER SUBSYSTEM AND ENVIRONMENTAL CONTROL SUBSYSTEM CONSUMABLES ANALYSIS AS DEFINED FOR CONFIGURATION CONTROL

By Martin L. Alexander, Richard C. Wadle,
Harry Kolkhorst, Richard M. Swalin,
and Roy E. Stokes,
Guidance and Performance Branch

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MSC INTERNAL NOTE NO. 68-FM-113

May 9, 1968

THE EFFECTS OF IU PLATFORM PITCH DRIFT RATES ON TLI FOR THE LUNAR LANDING MISSION

By Alexander Treadway,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-114

April 18, 1968

C-MISSION (205/101) NAVIGATION ERROR ANALYSIS

By Navigation Analysis Section
TRW Systems Group

MSC Task Monitor
P. Mitchell

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MSC INTERNAL NOTE NO. 68-FM-116

May 15, 1968

PRELIMINARY ABORT ΔV REQUIREMENTS FOR A COPERNICUS MISSION

By James C. Kirkpatrick,
Advanced Mission Design Branch

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MSC INTERNAL NOTE NO. 68-FM-117

MAY 15, 1968

RTCC REQUIREMENTS FOR MISSIONS F AND G: SELENOGRAPHIC-MNBY VELOCITY TRANSFORMATION FORMULATION

By Paul F. Flanagan,
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-98 dated April 19, 1968.)

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MSC INTERNAL NOTE NO. 68-FM-118

MAY 17, 1968

S-IVB TRANSPOSITION AND DOCKING ATTITUDES FOR MISSION D (AS-503/CSM-103/LM-3)

By Robert S. Merriam,
Orbital Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-119

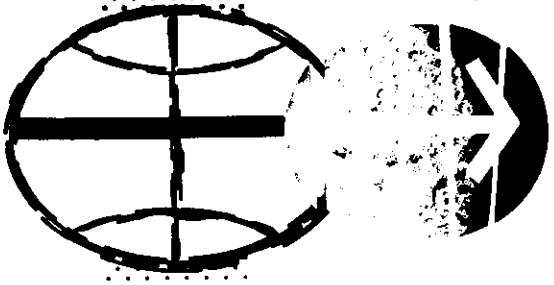
May 21, 1968

LOGIC FOR THE EARTH ORBITAL AEG IN THE APOLLO REAL-TIME RENDEZVOUS SUPPORT PROGRAM

By Edward J. Kenyon,

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-120

May 21, 1968

CSM-ACTIVE RENDEZVOUS SIMULATION STUDIES USING SEXTANT AND RANGING DEVICE

By B. F. Cockrell,

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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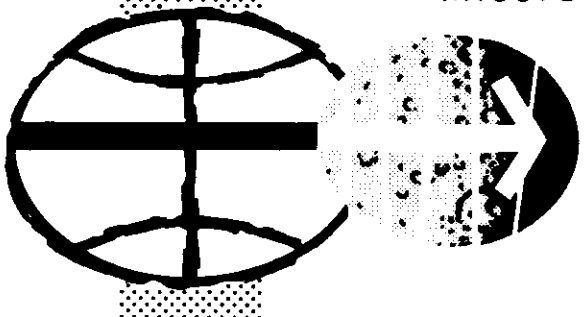
MSC INTERNAL NOTE NO. 68-FM-121

May 23,1968

SIGHTING COMBINATIONS FOR ORBITAL AND MIDCOURSE NAVIGATION DURING THE THIRD AND FOURTH HIGH ELLIPSES OF MISSION E

By Richard E. Eckelkamp,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-122

May 23, 1968

PRELIMINARY CONTINGENCY PROCEDURES FOR THE TRANSLUNAR INJECTION MANEUVER

By Bobbie D. Weber,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM- 123

MAY 27, 1968

REAL-TIME AUXILIARY COMPUTING FACILITY A-2/CSM-020 MISSION REPORT

By S.D. Holzaepfel
Flight Analysis Branch
and
P.A. DiValerio
D.C. McDougall
Mission Operations Section
TRW Systems Group

MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 68-FM-125

MAY 28, 1968

RTCC REQUIREMENTS FOR MISSION G: LUNAR MODULE ATTITUDE DETERMINATION USING ONBOARD OBSERVATION

By B.F. Cockrell
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-52 dated February 23, 1968.)

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NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: JAN 6 1969

68-FM47-408

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Change Sheet for MSC Internal Note 68-FM-125

1. Reference: MSC Internal Note No. 68-FM-125, "RTCC Requirements for Mission G: Lunar Module Attitude Determination Using Onboard Observation," FM4/B. F. Cockrell, May 28, 1968.

2. This memo specifies changes to the referenced document to incorporate revised definitions of the gravity vector direction and rendezvous radar angular coverage limits.

3. The direction of the gravity vector to be downlinked will have its origin at the center of the LM body axes and point in the general direction of the local vertical (i.e., up). The mode II (lunar surface) RR angular coverage limits are:

$$220^\circ \leq \text{Shaft} \leq 335^\circ$$

$$125^\circ \leq \text{Trunnion} \leq 235^\circ$$

4. The attached pages from the original report were changed to reflect the new definitions and should be inserted as replacements to the previous internal note pages of the same number.

James C. McPherson, Chief
Mathematical Physics Branch

The Flight Software Branch concurs with the above recommendation and requests IBM to proceed accordingly.

James C. Stokes, Jr., Chief
Flight Software Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Attachment

Distribution: (See attached list)

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NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

: See List Below

DATE: FEB 2 5 1969

69-FM47-28

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BJECT: Change Sheet for MSC Internal Note 68-FM-125

1. Reference: MSC Internal Note No. 68-FM-125, "RTCC Requirements for Mission G: Lunar Module Attitude Determination Using Onboard Observations," FM4/B. F. Cockrell, May 28, 1968.

2. This memo specifies a change to the reference document to revise the figure illustrating the rendezvous radar shaft and trunnion angles definitions in L.M. body coordinates.

3. The attached page from the original report was changed to reflect the new figure and should be inserted as replacement to the previous note page of the same number.

James C. McPherson, Chief
Mathematical Physics Branch

The Flight Software Branch concurs with the above recommendation and requests IBM to proceed accordingly.

James C. Stokes, Jr., Chief
Flight Software Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

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MSC INTERNAL NOTE NO. 68-FM-126

May 29, 1968

APOLLO MISSION E (AS-504/CSM-104/LM-4) SPACECRAFT REFERENCE TRAJECTORY VOLUME IV-CONSUMABLES ANALYSIS

By Arnold J. Loyd, Martin L. Alexander,
Richard C. Wadle, Harry Kolkhorst, Richard M. Swalin,
and Sam A. Kamen,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-100

April 15, 1968

BASIC EQUATIONS AND LOGIC FOR THE REAL-TIME GROUND NAVIGATION PROGRAM FOR THE APOLLO LUNAR LANDING MISSION

By Emil R. Schiesser, Howard G. deVezin,
Robert T. Savely, and Michael J. Oles,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 68-FM-129

June 4, 1968

MATHEMATICAL MODEL FOR THE LM LUNAR ASCENT HYBRID SIMULATION

By James V. West,

Lunar Landing Branch

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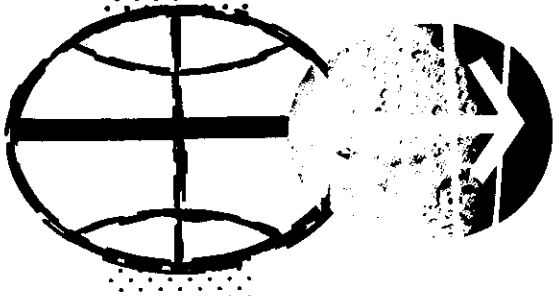

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MSC INTERNAL NOTE NO. 68-FM-130

June 5, 1968

FACTORS INFLUENCING THE GUIDANCE ACCURACY OF A PLANETARY PROBE

By Thomas B. Murtagh,
Advanced Mission Design Branch

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MSC INTERNAL NOTE NO. 68-FM-131

June 5, 1968

PRELAUNCH MEASURED WINDS AND A COMPARISON OF THE EFFECTS OF PRELAUNCH AND STATISTICAL WINDS ON MODE I ABORTS FROM A SATURN IB LAUNCH VEHICLE

By Dallas G. Ives and Samuel R. Newman,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-132

June 5, 1968

RTCC REQUIREMENTS FOR MISSIONS E AND G: TRANSLUNAR INJECTION PROCESSOR

By David S. Scheffman,
Jerome D. Yencharis, and Brody O. McCaffety

Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 68-FM-28 dated February 1, 1968)

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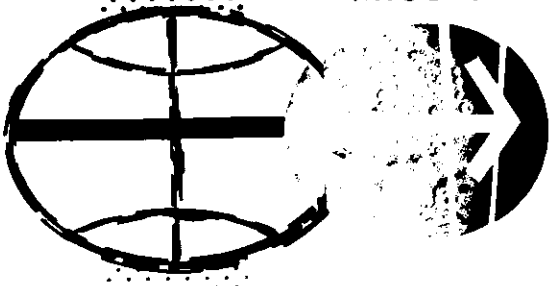

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MSC INTERNAL NOTE NO. 68-FM-133

JUNE 7, 1968

PRELIMINARY ANALYSES OF LM ABORT AND CSM RESCUE FROM 60-N. MI. CSM ORBIT DURING THE HOHMANN DESCENT PHASE

By Jerome A. Bell
and
Mary T. Alexander,
Orbital Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-140

June 12, 1968

MISSION G REQUIREMENTS FOR THE RTCC: NOMINAL ASCENT AND ABORT FROM DESCENT

By Veit Hanssen,
Lunar Landing Branch

(This document supersedes MSC Internal Note No. 67-FM-82 dated June 28, 1967)

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MSC INTERNAL NOTE NO. 68-FM-141

June 12, 1968

APOLLO MISSION D (AS-503/CSM-103/LM-3) SPACECRAFT REFERENCE TRAJECTORY VOLUME IV- CONSUMABLES ANALYSIS

By Samuel O. Mayfield, Martin L. Alexander, Richard C. Wadle, Harry E. Kolkhorst, Richard M. Swalin, and Sam A. Kamen,
Guidance and Performance Branch

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MSC INTERNAL NOTE NO. 68-FM-143

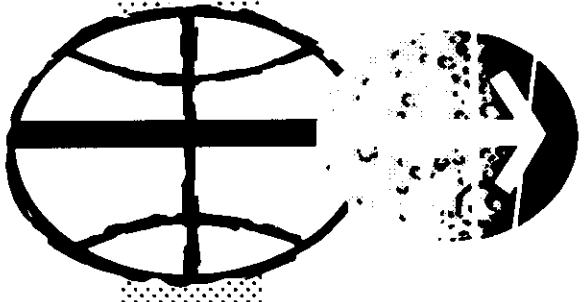
June 14, 1968

POWERED LUNAR ASCENT PERFORMANCE CHARACTERISTICS

By Billy G. Taylor,

Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-144

June 17, 1968

PRELIMINARY PROCEDURES FOR CONTINGENCIES OCCURING DURING THE HIGH ELLIPSE PHASE OF MISSION E

By Bobbie D. Weber,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-145

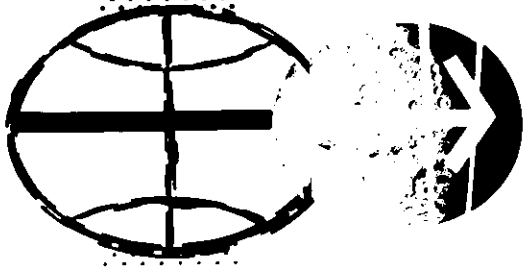
June 17, 1968

SENSITIVITY OF EARTH AND LUNAR ORBITS TO VELOCITY CHANGES AT PERIAPSIS AND APOAPSIS

By Bryson M. Pursell,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-146

June 17, 1968

LOGIC AND EQUATIONS FOR RTCC COMPUTATION OF LUNAR LANDING DESCENT TRAJECTORY

By Edwin G. Dupnick,
Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-147

June 24, 1968

APOLLO MISSION D (AS-503/CSM-103/LM-3) SPACECRAFT REFERENCE TRAJECTORY REVISION 1

By Harold L. Conway, Robert S. Merriam,
and
Harold O. Spurlin,
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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TO : See attached list

DATE: August 22, 1968

FROM : FM13/Chief, Mission Planning Support Office

File No. 68-FM13-492

SUBJECT: Revision II to Mission "D" (AS-503/CSM 103/LM-3) Spacecraft Reference Trajectory

The attached document represents revision II to the mission "D" Spacecraft Reference Trajectory. This document reflects the official changes to the Reference Trajectory revision I (MSC internal note 68-FM-147) and is published to provide an official interim document prior to publication of the Spacecraft Operational Trajectory. The major changes are as follows:

1. The assumed launch date (November 2, 1968 at 1500 gmt) has been changed to December 15, 1968 at 1500 gmt.

2. Minor shifts in burn initiation times due to an updated MSFC state vector at LM extraction, which includes S-IVB venting.

3. SPS-5, originally scheduled following EVA, has been shifted to the third period of activities following the docked DPS burn.

4. The APS burn-to-depletion and SPS-6 and SPS-7 have been shifted to provide better station coverage and crew workload.

5. An additional SPS burn (SPS-8) is included for end-of-mission trajectory adjustment prior to deorbit.

Volume II (detailed trajectory listing) will be published around September 10. The consumables analysis for this revision will be published about October 1. Any questions or comments concerning the attached document or its distribution can be directed to this office.

The Apollo trajectory documentation distribution list has been changed to reduce the number of copies of the documents which must be printed. This was done to alleviate some of the overload on the NASA printing facilities. The attached list reflects this reduction. It should be reviewed

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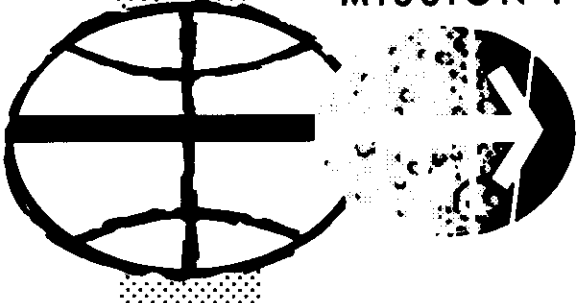
MSC INTERNAL NOTE NO. 68-FM-149

June 20, 1968

CIRCUMLUNAR COMMUNICATIONS USING TWO SATELLITES IN LUNAR POLAR ORBIT

By John T. McNeeley
and
Ellis W. Henry,
Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-150

June 21, 1968

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STUDY OF FEASIBILITY OF EMPLOYING THE SM RCS TO DEORBIT THE APOLLO 7 SPACECRAFT FOLLOWING A PREMATURE SPS CUTOFF

By Alexie H. Benney, Jr.
and David J. Griffith,
Orbital Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-153

June 24, 1968

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APOLLO 7 MISSION ONBOARD MONITORING ANALYSIS FOR EACH SPS BURN

By James L. Wells, Jr.,
Guidance and Performance Branch

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MSC INTERNAL NOTE NO. 68-FM-155

June 25, 1968

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RTCC REQUIREMENTS FOR THE TLI BURN GO - NO-GO PROCEDURE

By Herbert S. Estes,
Guidance and Performance Branch

(This revision supersedes MSC Internal Note No. 68-FM-85 dated April 3, 1968)

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MSC INTERNAL NOTE 68-FM-155 DATED JUNE 25, 1968

RTCC REQUIREMENTS FOR THE TLI BURN GO/NO-GO

PROCEDURE

By Herbert S. Estes

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October 1, 1969

Marlowe D. Cassetti, Chief
Guidance and Performance Branch

for John P. Mayer, Chief
Mission Planning and Analysis
Division

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MSC INTERNAL NOTE NO. 68-FM-157

June 27, 196

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CONSUMABLES ANALYSIS FOR THE APOLLO MISSION E (AS-504/CSM-104/LM-4) SPACECRAFT REFERENCE TRAJECTORY - REVISION I

By Arnold J. Loyd, Martin L. Alexander,
Richard C. Wadle, Harry Kolkhorst,
Richard M. Swalin and Sam A. Kamen
Guidance and Performance Branch

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MSC INTERNAL NOTE NO. 68-FM-158

July 31, 1968

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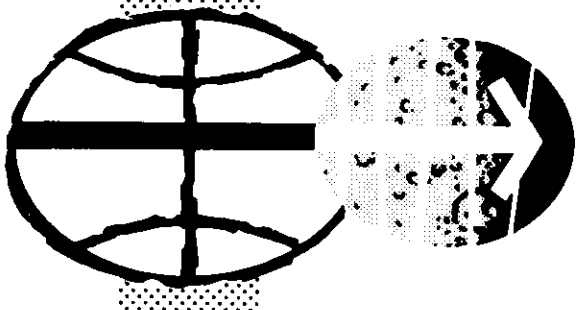
AN EMPIRICAL SIMULATION EQUATION EXPRESSING THE CHARACTERISTIC VELOCITY OF OPTIMUM TLI MANEUVERS FOR ALL MISSIONS

By Francis Johnson, Jr.,

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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Memorandum

TO : See list below

DATE: 26 APR 1968

68-FM51-158

FROM : FM5/Lunar Mission Analysis Branch
FM6/Orbital Mission Analysis Branch

SUBJECT: RTCC requirements for E mission - updates to SLV guidance equations

The attached internal note change updates the Saturn guidance equations contained in Internal Note No. 67-FM-82. These changes are required for the E mission RTCC system.

Ronald L. Berry, Acting Chief
Lunar Mission Analysis Branch

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees: (See attached list)

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A METHOD FOR DETERMINING OPTIMAL, FIXED-TIME, N-IMPULSE TRAJECTORIES BETWEEN ARBITRARILY INCLINED ORBITS

By Donald J. Jezewski,
Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-160

July 3, 1968

SLA PANEL JETTISON SEPARATION AND RECONTACT ANALYSIS

By Marland L. Williamson
and
Charles W. Fraley,
Flight Analysis Branch

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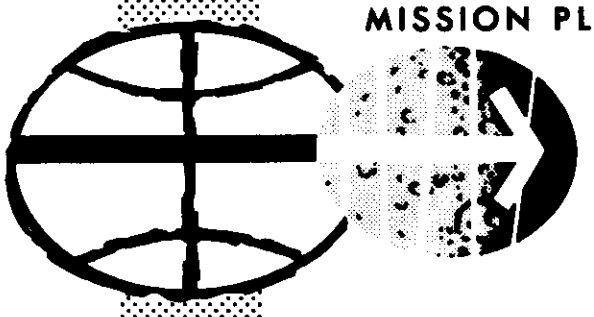

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MSC INTERNAL NOTE NO. 68-FM-128

June 4, 1968

PRELIMINARY DISPERSION ANALYSIS OF FIVE RENDEZVOUS PROFILES FOR AAP MISSION AAP-1/AAP-2

By Larry Hartley,

Orbital Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-164

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A PERFORMANCE STUDY OF THE SUNDISK REENTRY GUIDANCE PROGRAM FOR EARTH ORBITAL MISSION

By Joseph E. Rogers,

Lunar Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-165

July 12, 1968

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EFFECTS OF GUIDANCE AND NAVIGATION SYSTEM ERRORS ON THE APOLLO 7 MISSION

By Melvin R. Rother,

Guidance and Performance Branch

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MSC INTERNAL NOTE NO. 68-FM-166

October 4, 1968

BIAS EFFECTS ON POSTFLIGHT DATA

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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July 15, 1968

MINIMUM ΔV, THREE-IMPULSE, NON-COPLANAR TRANSFER FROM A CIRCULAR PARKING ORBIT ONTO AN ASYMPTOTIC VELOCITY VECTOR FOR SMALL DECLINATION ANGLES: AN APPROACH TO THE TRANS-MARS LAUNCH WINDOW PROBLEM

By William C. Bean,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-168

July 8, 1968

APOLLO MISSION E: AS-504/CSM-104/LM-4 SPACECRAFT PRELIMINARY ALTERNATE MISSION STUDIES

By Mission Analysis Laboratory
TRW Systems Group

MSC Task Monitor
Cathy Osgood

MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 68-FM-169

July 16, 1968

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SUN-IN-THE-WINDOW ANALYSIS FOR THE APOLLO 7 NOMINAL LAUNCH PHASE AND THE MODE III, FIXED-ΔV, AND MODE IV ABORTS

By Robert E. Prahl,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-170

July 19, 1968

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SPACECRAFT OPERATIONAL ABORT PLAN FOR APOLLO 7 (MISSION C)

VOLUME II - CSM LAUNCH ABORTS

By Edward M. Henderson,
Flight Analysis Branch,
and
J. V. Butler,
Mission Operational Section, TRW Systems Group

MISSION PLANNING AND ANALYSIS DIVISION

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FM13/H.A. Goodwin

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See attached list

DATE: OCT 9 1968
File No. 68-FM13-612

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Update to the Spacecraft Operational Abort Plan for Apollo 7

This memorandum identifies the attached document as a program-level document for the Apollo 7 mission. Insufficient time is available to produce an internal note.

The CSM launch aborts described in MSC internal note 68-FM-170 have been updated to reflect changes in the launch trajectory, spacecraft aerodynamics, and the SPS.

Updates to the LEV aborts (MSC internal note 68-FM-224) and the contingency deorbit report (MSC internal note 68-FM-208) are not required. Further revisions to the Apollo 7 abort plans are not expected.

R. P. Parten

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
(See attached list)

FM13:JRGurley:pj

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Mission Planning & Analysis Division

TO : See attached list

DATE: OCT 4 1968

File No. 68-FM13-603

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Apollo 7 (mission C) Revision II to the Operational Consumables Analysis

This memorandum identifies the attached document as a program-level document for the Apollo 7 mission. This revised operational consumables analysis includes revisions to the SPS, RCS, EPS, and cryogenics loadings and/or usage profiles.

The SPS and RCS propellant margins have changed slightly. The hydrogen is still showing a slightly negative margin, and the oxygen margin is slightly positive.

The SPS ΔV requirements in Revision II to the Operational Trajectory (MSC internal note 68-FM-245) resulted in increased propellant usage. The RCS profile revisions reflect changes in the Flight Plan. The EPS profile reflects updated master electrical equipment lists, updated prelaunch procedures, loss of the VAC-ION pumps, and limited battery-charging procedures.

The actual consumables loaded in the CSM will be described in a subsequent memorandum at L-3 days.

R. P. Parten

APPROVED BY:

for John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
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MSC INTERNAL NOTE NO. 68-FM-171

July 17, 1968

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LANDMARK ORBITAL NAVIGATION PLAN FOR APOLLO 7

By Richard E. Eckelkamp,
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 67-FM-163 dated November 1, 1967)

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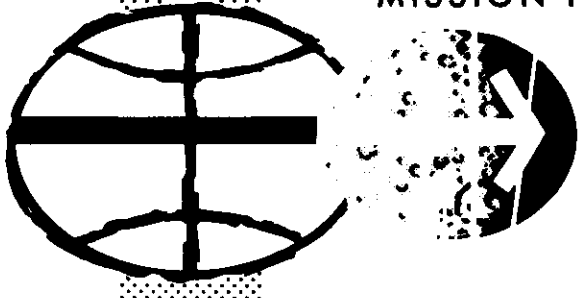

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MSC INTERNAL NOTE NO. 68-FM-172

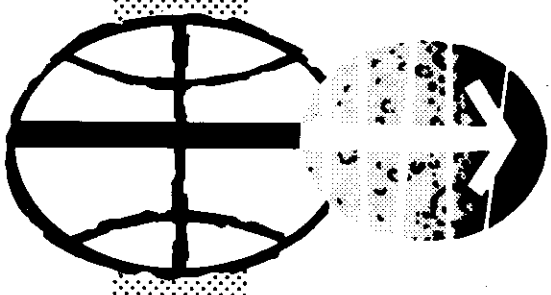
July 17, 1968

THE DETERMINATION OF ATTITUDE DEVIATION LIMITS FOR TERMINATING A NON-NOMINAL TRANSLUNAR INJECTION MANEUVER

By Charles T. Hyle and Alexander H. Treadway,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-173

July 18, 1968

RTCC REQUIREMENTS FOR MISSION G: LOI TARGETING PROCESSOR

By Robert F. Wiley,

Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 68-FM-34 dated February 1, 1968)

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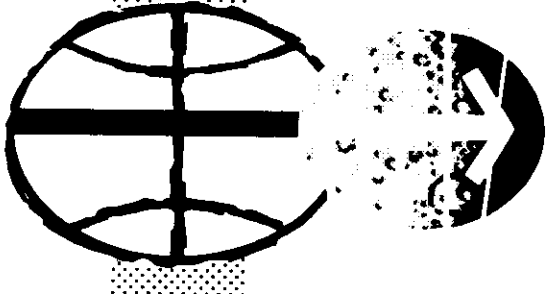

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MSC INTERNAL NOTE NO. 68-FM-174

July 19, 1968

PRELIMINARY ANALYSIS OF LM ABORT AND CSM RESCUE FROM A 60 - N. MI. CIRCULAR ORBIT FOLLOWING AN LM ABORT FROM POWERED DESCENT

By Jerome A. Bell and Allan L. Dupont,
Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-65 dated May 5, 1967)

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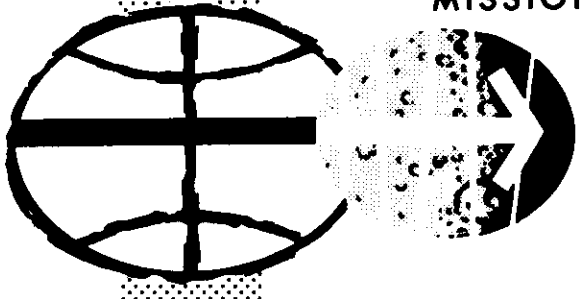

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MSC INTERNAL NOTE NO. 68-FM-177

July 22, 1968

A ONE-PHASE TARGETING CONCEPT FOR THE LM POWERED DESCENT

By James H. Alphin,
Lunar Landing Branch

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MSC INTERNAL NOTE NO. 68-FM-179

July 31, 1968

APOLLO 7 SPACECRAFT OPERATIONAL TRAJECTORY REVISION 1 VOLUME III - TRACKING TIME HISTORIES

By Alexie H. Benney, Jr.,
Samuel L. Miller, and Fred C. Jensen,
Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 68-FM-112, dated May 7, 1968)

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MSC INTERNAL NOTE NO. 68-FM-163

July 10, 1968

APOLLO 7 (MISSION C) OPERATIONAL ALTERNATE MISSION PLAN

By Alexie H. Bonney, Jr. and Samuel L. Miller

Orbital Mission Analysis Branch

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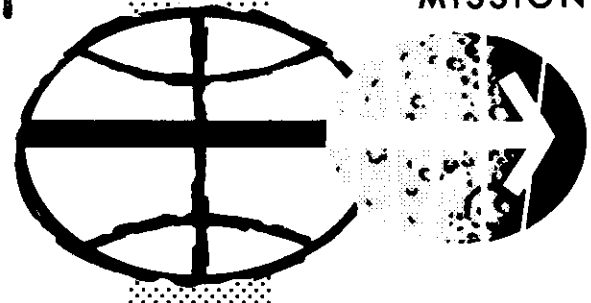
MSC INTERNAL NOTE NO. 68-FM-181

July 31, 1968

APOLLO MISSION E
(AS-504/CSM-104/LM-4)
SPACECRAFT REFERENCE TRAJECTORY
REVISION 2
VOLUME I - MISSION PROFILE

By David D. DeAtkine and Alexander Woronow,
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-184

July 31, 1968

APOLLO 7 SPACECRAFT OPERATIONAL TRAJECTORY (REVISION I) VOLUME I - MISSION PROFILE

By Alexie H. Benney, Jr., Samuel L. Miller,
and Fred C. Jensen,
Orbital Mission Analysis Branch,
and David W. Heath,
Lunar Landing Branch

(This revision supersedes MSC Internal Note No. 68-FM-110, dated May 22, 1968)

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UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See attached list

DATE: SEP 26 1968
File No. 68-FM13-579

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Revision II to the Apollo 7 (C mission) Spacecraft Operational Trajectory

The attached document presents the second revision to the Spacecraft Operational Trajectory (OT). It reflects the official changes to revision I (MSC internal note 68-FM-184). The changes are as follows:

1. The third SPS burn is increased to 9.2 seconds.
2. The CSM weight is increased by 200 pounds.
3. The CM aerodynamics coefficients are updated.
4. The revised launch trajectory is reflected.
5. The deorbit maneuver is retargeted.
6. The sixth SPS burn is directed out-of-plane.
7. The seventh SPS burn has an out-of-plane component.
8. The CSM orbital drag model is updated.
9. The landing target point is changed.

These changes are considered minor; and therefore, a Volume II-type document will not be published. Further revisions to the OT are not expected.

R P Parten
R. P. Parten

APPROVED BY:

for Carl R. Huss
John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
(See attached list)

FM13:JRGurley:pj

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DATE: 5/22/70

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MSC INTERNAL NOTE NO. 68-FM-186

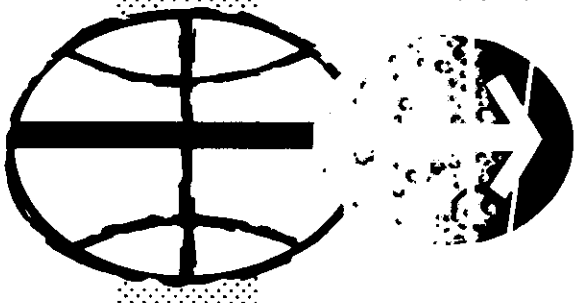
July 31, 1968

CHARACTERISTIC VELOCITY ANALYSIS FOR THE LUNAR DESCENT

By Billy G. Taylor,

Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-187

August 1, 1968

COMPARISON OF A TWO-BURN SCHEME TO AN RCS INSERTION TECHNIQUE FOR LUNAR ASCENT

By William C. Lamey,

Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-188

August 1, 1968

RADAR DATA FOR CHOOSING PASSES TO SATISFY THE APOLLO 7 (AS-205/CSM-101) RENDEZVOUS RADAR TEST OBJECTIVE

By Samuel L. Miller,
Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 68-FM-152, dated June 25, 1968)

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MSC INTERNAL NOTE NO. 68-FM-192

August 5, 1968

DROOPING TRAJECTORY DURING THE FINAL APPROACH PHASE OF THE LUNAR LANDING MISSION

By Moises N. Montez,
Lunar Landing Branch

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MSC INTERNAL NOTE NO. 68-FM-193

August 9, 1968

RTCC REQUIREMENTS FOR MISSION G: THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

By Bernard F. Morrey, Brody O. McCaffety,

and Alfred E. Morrey,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 68-FM-151, dated June 21, 1968)

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MSC INTERNAL NOTE NO. 68-FM-194

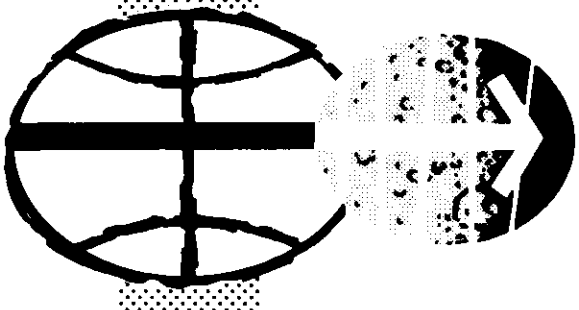
August 6, 1968

A MANUALLY THROTTLED THRUST PROFILE FOR DOI

By Otis F. Graf,

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-196

August 9, 1968

APOLLO MISSION G SPACECRAFT REFERENCE TRAJECTORY VOLUME I - REFERENCE MISSION PROFILE (LAUNCHED AUGUST 14, 1969)

By Lunar Mission Analysis Branch,
Lunar Landing Branch,
and Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-180

July 31, 1968

APOLLO 7 SPACECRAFT OPERATIONAL TRAJECTORY REVISION 1 VOLUME II - TRAJECTORY LISTING

By Alexie H. Benney, Jr., Samuel L. Miller,
and Fred C. Jensen,
Orbital Mission Analysis Branch,
and David W. Heath,
Lunar Landing Branch

(This revision supersedes MSC Internal Note No. 68-FM-111, dated May 20, 1968)

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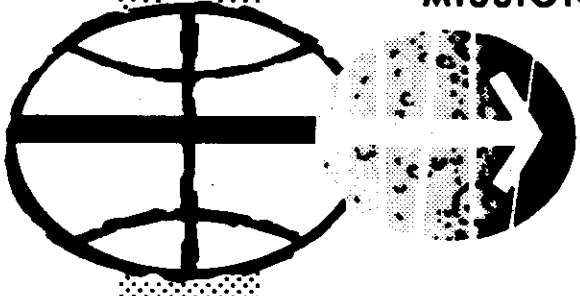
MSC INTERNAL NOTE NO. 68-FM-204

August 14, 1968

APOLLO 7 OPERATIONAL CONSUMABLES ANALYSIS

By Don A. Nelson, Harry E. Kolkhorst,
Sam A. Kamen, Richard M. Swalin,
Richard C. Wadle, Walter Scott,
and Dwight E. Peterson,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-205

August 16, 1968

A SCHEME FOR IMPROVING THE LM LANDING RADAR ALTITUDE UPDATING OF THE PGNCS

By William F. Haldeman,
Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-206

AUGUST 15, 1968

APOLLO 7 CSM/S-IVB LAUNCH ABORT SEPARATION AND RECONTACT ANALYSIS

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

MSC Task Monitor
M. L. Williamson

MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 68-FM-207

August 16, 1968

REAL-TIME TARGETING FOR THE APOLLO LUNAR ORBIT INSERTION MANEUVER

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-208

August 20, 1968

SPACECRAFT OPERATIONAL ABORT PLAN FOR APOLLO 7 (MISSION C) VOLUME III - CONTINGENCY ANALYSIS REPORT

By Mission Support Section,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE HISTORY FOR 68-FM-208

Change no.	Date	Description
1	9/17/68	Replace page 36 - defines the nominal retro-pitch angle and dispersion.

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DATE: 5/22/70

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MSC INTERNAL NOTE NO. 68-FM-209

November 26, 1968

OPERATIONAL ABORT PLAN FOR THE APOLLO 8 MISSION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE HISTORY FOR 68-FM-209

Change no.	Date	Description
1	12/5/68	Pen-and-ink changes are made to pages 5-7, 5-55, 7-51, 8-9, 8-11, and 8-37 to correct errors in the original document. Pages 7-61, 7-62, 7-63, and 7-64 are replaced for the same reason.

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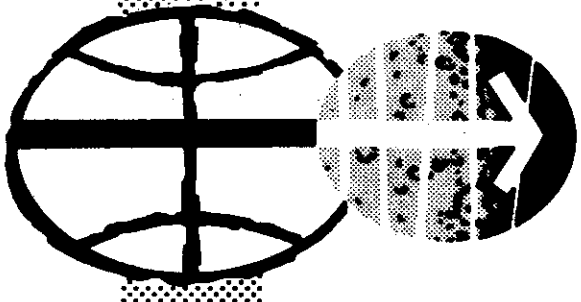
MSC INTERNAL NOTE NO. 68-FM-210

August 22, 1968

REVISION 2 TO THE APOLLO MISSION D SPACECRAFT REFERENCE TRAJECTORY VOLUME I - NOMINAL TRAJECTORY

By Harold L. Conway, Robert S. Merriam,
and Harold O. Spurlin,
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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UNITED STATES GOVERNMENT

Memorandum

[redacted] Manned Spacecraft Center
[redacted] Planning & Analysis Division

TO : See attached list

DATE: SEP 25 1968

File No. 68-FM13-571

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Revision II to the Apollo mission D Spacecraft Reference Trajectory, Volume IV--Consumables Analysis

The attached memorandum fulfills the Apollo Documentation Schedule for the subject document. Distribution has been made according to the attached list. Any questions or comments should be referred to this office.

R. P. Parten

APPROVED BY:

for John P. Mayer
Chief, Mission Planning
and Analysis Division

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Addressees:
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MSC INTERNAL NOTE NO. 68-FM-211

August 22, 1968

PRELIMINARY CONTINGENCY PROCEDURES FOR THE LUNAR ORBIT INSERTION, LUNAR ORBIT, AND TRANSEARTH INJECTION PHASES OF THE LUNAR MISSION

By Samuel R. Newman and Charles E. Foggatt,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-212

AUGUST 28, 1968

DETAILED CREW PROCEDURES FOR POWERED FLIGHT EVALUATION OF THE TRANSLUNAR INJECTION MANEUVER

By Charles T. Hyle,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-213

August 15, 1968

REENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR MISSION C/CSM-101 (APOLLO 7)

By Flight Analysis Section
TRW Systems Group

MSC Task Monitor
David W. Heath

MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 68-FM-214

REVISION 1 TO THE APOLLO MISSION D SPACECRAFT REFERENCE TRAJECTORY VOLUME IV-CONSUMABLES ANALYSIS

By Samuel O. Mayfield, Martin L. Alexander,
Richard C. Wadle, Harry Kolkhorst, Richard M. Swalin,
Sam A. Kamen, and Dwight G. Peterson,
Guidance and Performance Branch

(This revision supersedes MSC Internal Note No. 68-FM-141 dated May 12, 1968.)

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MSC INTERNAL NOTE NO. 68-FM-215

THIRD BODY CALIBRATION LOGIC FOR THE EARTH-CENTERED CONIC ABORT SUBPROCESSOR OF THE RETURN-TO-EARTH ABORT PROCESSOR

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-216

August 30, 1968

RTCC REQUIEMENTS FOR MISSIONS D, E, AND F: REENTRY PHASE

By James W. Tolin, Jr.,

John K. Burton and Joseph E. Rogers,

Lunar Landing Branch

(This revision supersedes MSC Internal Note No. 68-FM-102 dated April 24, 1968)

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UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: DEC 9 1968
68-FM23-207

FROM : FM2/Landing Analysis Branch

SUBJECT: Change sheet No. 3 to MSC Internal Note 68-FM-216

Reference is made to MSC Internal Note 68-FM-216, "RTCC requirements for Missions D, E, and F reentry phase," by J. W. Tolin, J. K. Burton, and J. E. Rogers, dated August 30, 1968.

The change described in the attached change sheet should be made to the above referenced document.

This change is to provide protection against a possible program loop within the RTCC.

Floyd V. Bennett
Chief, Landing Analysis Branch

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Addressees: (See attached list)

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Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: 30 OCT 1968

68-FM23-179

FROM : FM2/Landing Analysis Branch

SUBJECT: Change sheet No. 2 to MSC Internal Note 68-FM-216

Reference is made to MSC Internal Note 68-FM-216, "RTCC requirements for Missions D, E, and F reentry phase," by J. W. Tolin, J. K. Burton, and J. E. Rogers, dated August 30, 1968.

The change described in the attached change sheet should be made to the above referenced document.

This change is necessitated by errors in the reference.

Floyd V. Bennett
Chief, Landing Analysis Branch

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Addressees: (See attached list)

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NASA-Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: 30 SEP 1968

68-FM2-136

FROM : FM2/Landing Analysis Branch

SUBJECT: Change sheet to MSC Internal Note 68-FM-216

Reference is made to MSC Internal Note 68-FM-216, "RTCC requirements for Missions D, E, and F reentry phase," by J. W. Tolin, J. K. Burton, and J. E. Rogers, dated August 30, 1968.

The changes described in the attached change sheet should be made to the above referenced document.

These changes are necessitated by errors in the reference.

Floyd V. Bennett
Chief, Landing Analysis Branch

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

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MSC INTERNAL NOTE NO. 68-FM-217

September 3, 1968

PRELIMINARY LAUNCH ABORT STUDY FOR APOLLO MISSION D/CSM-103/LM-3

By E. M. Henderson

Flight Analysis Branch

and

R. W. Schutt

Contingency Studies Section
TRW Systems Group

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MSC INTERNAL NOTE NO. 68-FM-203

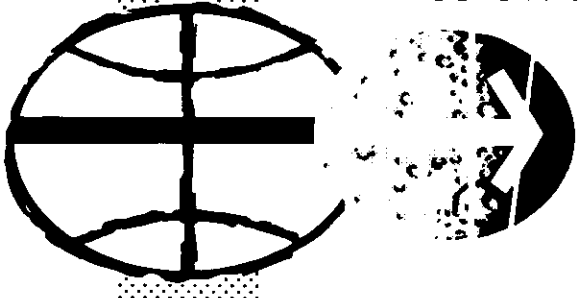
August 12, 1968

COMPATIBILITY OF LM PGNCS AND AGS CONCENTRIC RENDEZVOUS MANEUVER COMPUTATIONS

By Dennis M. Braley, Ernest M. Fridge,
Robert N. Hinson, and Elric N. McHenry,
Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note
No. 68-FM-95 dated April 17, 1968)

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-197

August 16, 1968

APOLLO MISSION G REFERENCE TRAJECTORY VOLUME II REFERENCE MISSION PROFILE TRAJECTORY PARAMETERS (LAUNCHED AUGUST 14, 1969)

By Lunar Mission Analysis Branch,
Lunar Landing Branch,
and Orbital Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-219

September 3, 1968

REVISION 1 TO THE APOLLO 7 OPERATIONAL CONSUMABLES ANALYSIS

By Don A. Nelson, Harry E. Kolkhorst,
Sam A. Kamen, Richard M. Swalin, Richard C. Wadle,
Walter Scott and Dwight G. Peterson,
Guidance and Performance Branch

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MSC INTERNAL NOTE NO. 68-FM-220

September 5, 1968

APOLLO MISSION D PRELIMINARY LM ABORT AND CSM RESCUE PLAN

By Larry D. Hartley and Stanton A. Glantz,
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-221

September 6, 1968

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TECHNIQUES FOR PREDICTING OPTIMUM INTERPLANETARY MIDCOURSE VELOCITY-CORRECTION SCHEDULES

By Thomas B. Murtagh,

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-222

September 11, 1968

PRELIMINARY CONTINGENCY PROCEDURES FOR THE TRANSLUNAR COAST

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MSC INTERNAL NOTE NO. 68-FM-223

September 11, 1968

A DESCRIPTION OF THE INPUT TO THE APOLLO MISSION PLANNING AND REAL-TIME RENDEZVOUS SUPPORT PROGRAM

By Jerome W. Kahanek and William A. Reini,
Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-165 dated November 3, 1967)

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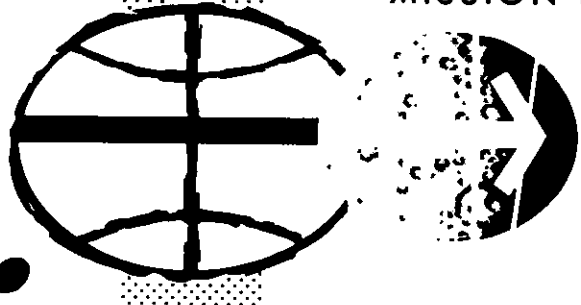

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Mission Planning & Analysis Division

TO : See List Below

DATE: 24 SEP 1968

FROM : FM6/Orbital Mission Analysis Branch

68-FM63-303

SUBJECT: Change 1 to the input to the Apollo Mission Planning and Real-Time Rendezvous Support Program

Reference: Kahanek, J. W. and Reini, W. A.: A Description of the Input to the Apollo Mission Planning and Real-Time Rendezvous Support Program, MSC Internal Note No. 68-FM-223, September 11, 1968.

The enclosed document is change 1 to the referenced internal note. These changes correct typing, input deficiencies, and describe new input to the Apollo Mission Planning and Real-Time Rendezvous Support Program.

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
(See attached list)

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Memorandum

: See List Below

DATE: NOV 2 9 1968

68-FM63-346

M : FM6/Orbital Mission Analysis Branch

JECT: Change 2 to the input to the Apollo Mission Planning and Real-Time Rendezvous Support Program

Reference: Kahanek, J. W. and Reini, W. A.: A Description of the Input to the Apollo Mission Planning and Real-Time Rendezvous Support Program, MSC Internal Note No. 68-FM-223, September 11, 1968.

The enclosed document is change 2 to the referenced internal note. These changes correct typing, input deficiencies, and describe new input to the Apollo Mission Planning and Real-Time Rendezvous Support Program.

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
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MSC INTERNAL NOTE NO. 68-FM-224

September 12, 1968

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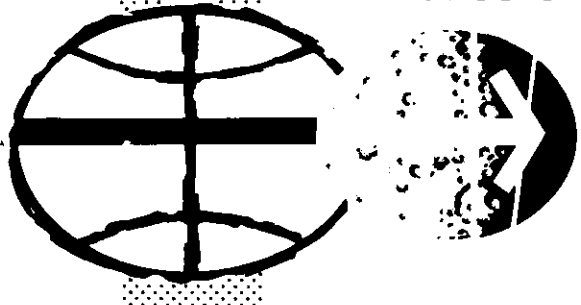
SPACECRAFT OPERATIONAL ABORT PLAN FOR APOLLO 7 (MISSION C) VOLUME 1-LEV ABORTS

By Dallas G. Ives and Samuel R. Newman,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-225

September 13, 1968

APOLLO 7
DISPERSION ANALYSIS

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Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See attached list

DATE OCT 3 1968
File No. 68-FM13-596

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Update to the Apollo 7 (mission C) Dispersion Analysis

This memorandum identifies the attached document as a program-level document for the Apollo 7 mission. Insufficient time is available to produce an internal note.

The dispersion analysis, documented in MSC internal note 68-FM-225, has been updated to reflect the latest mission plan (revision II to the Operational Trajectory) and recent performance changes.

R P Parten
R. P. Parten

APPROVED BY:

Carl R. Huss
for John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
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FM13:JRGurley:pj

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MSC INTERNAL NOTE NO. 68-FM-226

September 13, 1968

POSTFLIGHT ANALYSIS OF APOLLO 6 RADAR TRACKING DATA

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MSC INTERNAL NOTE NO. 68-FM-227

September 20, 1968

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EFFECTS OF WATER BOILER VENTING ON THE APOLLO 6 MISSION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-228

September 17, 1968

VERIFICATION OF UNIT LIST RESULTS FOR THE CONVERGENCE PROCESSOR MODULE OF THE APOLLO MISSION D GROUND ORBIT DETERMINATION PROGRAM

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MSC INTERNAL NOTE NO. 68-FM-229

September 17, 1968

APOLLO MISSION D-a/CSM-103/LM-3 REVISED SPACECRAFT REFERENCE TRAJECTORY VOLUME IV - CONSUMABLES ANALYSES

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MSC INTERNAL NOTE NO. 68-FM-230

November 25, 1968

APOLLO 8 SPACECRAFT OPERATIONAL ALTERNATE MISSION PLANS

VOLUME II - LUNAR ALTERNATE MISSIONS

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MSC INTERNAL NOTE NO. 68-FM-231

September 20, 1968

PARTIAL DERIVATIVES OF MATRICES REPRESENTING RIGID BODY ROTATIONS

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MSC INTERNAL NOTE NO. 68-FM-232

December 4, 1968

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CSM LAUNCH ABORT ANALYSIS

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MSC INTERNAL NOTE NO. 68-FM-233

September 18, 1968

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VERIFICATION OF THE REFRACTION MODULE OF THE IBM RTCC NAVIGATION PROGRAM IN SUPPORT OF MISSION D

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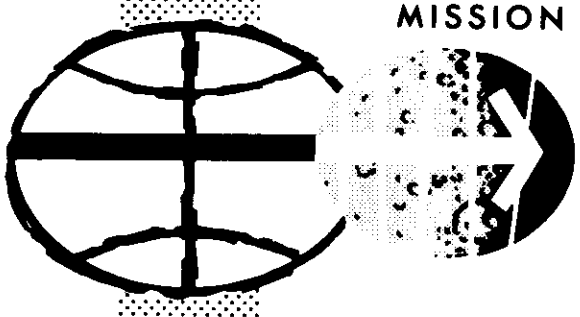

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MSC INTERNAL NOTE NO. 68-FM-234

September 20,1968

REVIEW OF THE SUNDISK CISLUNAR MIDCOURSE NAVIGATION PROGRAM

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MSC INTERNAL NOTE NO. 68-FM-235

September 20, 1968

APOLLO MISSION D
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NAVIGATION ERROR ANALYSIS

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MSC INTERNAL NOTE NO. 68-FM-236

September 23, 1968

REVISION 2 OF THE CONSUMABLES ANALYSIS FOR THE APOLLO MISSION E SPACECRAFT REFERENCE TRAJECTORY

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MSC INTERNAL NOTE NO. 68-FM-237

September 6, 1968

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 7 FLIGHT ANNEX

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MSC INTERNAL NOTE NO. 68-FM-218

August 28, 1968

SPACECRAFT REFERENCE TRAJECTORY FOR THE APOLLO C′ MISSION - ALTERNATE 1

By Robert E. Ernull,

Lunar Mission Analysis Branch

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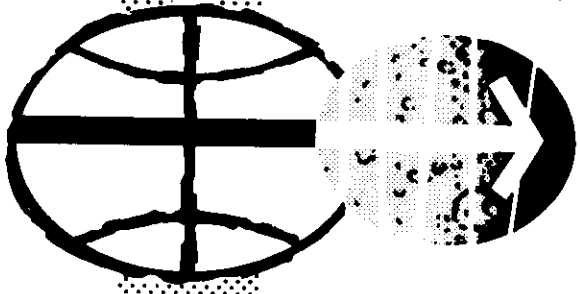

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MSC INTERNAL NOTE NO. 68-FM-240

September 26, 1968

GUIDANCE TECHNIQUES FOR LM RCS INSERTION

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MSC INTERNAL NOTE NO. 68-FM-241

SEPTEMBER 16, 1968

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E-MISSION (AS-504/CSM-104/LM-4) NAVIGATION ERROR ANALYSIS

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MSC INTERNAL NOTE NO. 68-FM-242

September 27, 1968

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REVISION 1 TO MISSION C/CSM-101 (APOLLO 7) SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

(This revision supersedes MSC Internal Note No. 68-FM-176 dated July 15, 1968)

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MSC INTERNAL NOTE NO. 68-FM-244

October 3, 1968

GUIDANCE ANALYSIS OF AERODYNAMIC BRAKING INTO ORBIT AROUND MARS

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MSC INTERNAL NOTE NO. 68-FM-245

PROJECT APOLLO

APOLLO 7 SPACECRAFT OPERATIONAL TRAJECTORY (REVISION 2)
VOLUME I - MISSION PROFILE

By Alexie H. Benney, Samuel L. Miller, and Fred C. Jensen
Orbital Mission Analysis Branch

October 4, 1968

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Approved: Edgar C. Lineberry
Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

Approved: for Carl R. Huss
John P. Mayer, Chief
Mission Planning and Analysis Division

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MSC INTERNAL NOTE NO. 68-FM-246

October 10, 1968

CONSUMABLES ANALYSIS FOR THE APOLLO MISSION G REFERENCE TRAJECTORY

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MSC INTERNAL NOTE NO. 68-FM-248

OCTOBER 11, 1968

MPAD VERIFICATION OF APOLLO 7 FLIGHT MISSION RULES

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APOLLO 7 OPERATIONAL SUPPORT TEAM HANDBOOK

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MSC INTERNAL NOTE NO. 68-FM-250

September 30, 1968

SPACECRAFT REFERENCE TRAJECTORY FOR THE APOLLO C' MISSION - ALTERNATE 1 REV 1

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October 10, 1968

TRAJECTORY STUDIES ON THE LUNAR DESCENT HYBRID SIMULATOR

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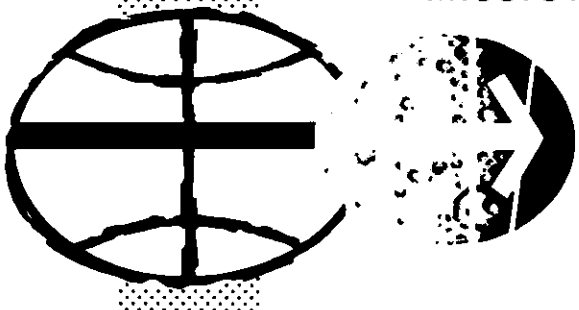

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APOLLO MISSION C' SPACECRAFT OPERATIONAL TRAJECTORY ALTERNATE 1, LUNAR ORBITAL MISSION

VOLUME II

TRAJECTORY PARAMETERS FOR A MISSION LAUNCHED DECEMBER 21, 1968

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MSC INTERNAL NOTE NO. 68-FM-254

October 16, 1968

APOLLO MISSION C' SPACECRAFT OPERATIONAL TRAJECTORY ALTERNATE 1, LUNAR ORBITAL MISSION

VOLUME III - SUMMARY OF MISSIONS FOR DECEMBER 1968 LAUNCH WINDOW

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October 11, 1968

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VERIFICATION OF SUNDISK ORBITAL NAVIGATION PROGRAM

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MSC INTERNAL NOTE NO. 68-FM-239

September 26, 1968

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INPUT TO THE EARTH ORBIT APOLLO GUIDANCE ANALYSIS STATISTICAL TRIALS PROGRAM

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MSC INTERNAL NOTE NO. 68-FM-258

October 8, 1968

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ERROR ANALYSES OF TYPICAL APOLLO SPACECRAFT MANEUVERS USING THE PGNCS AND SCS TO CONTROL THE SPS

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MSC INTERNAL NOTE NO. 68-FM-259

October 8, 1968

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ERROR ANALYSES OF TYPICAL APOLLO SPACECRAFT MANEUVERS USING THE PGNCS AND SCS TO CONTROL THE RCS

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MSC INTERNAL NOTE NO. 68-FM-260

November 29, 1968

A FINITE DIFFERENCING METHOD OF COMPUTING THE STATE TRANSITION MATRIX FOR ANY TYPE OF TRAJECTORY MODEL, CONIC THROUGH N-BODY

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MSC INTERNAL NOTE NO. 68-FM-261

October 18, 1968

AN ANALYTIC METHOD FOR COMPUTING THE STATE TRANSITION MATRIX WHICH INCLUDES THE FIRST-ORDER SECULAR PERTURBATIONS OF PLANET OBLATENESS

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MSC INTERNAL NOTE NO. 68-FM-263

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LM DESCENT AND ASCENT ΔV BUDGETS FOR THE LUNAR LANDING MISSION (APOLLO MISSION G)

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MSC INTERNAL NOTE NO. 68-FM-264

October 25, 1968

APOLLO MISSION F
SPACECRAFT REFERENCE TRAJECTORY
VOLUME II - REFERENCE MISSION PROFILE TRAJECTORY PARAMETERS
(LAUNCHED AUGUST 14, 1969)

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MSC INTERNAL NOTE NO. 68-FM-265

December 9, 1968

ACCURACY OF THE RTCC "LM DESCENT PERCENT MARGIN" DISPLAYS FOR THE LUNAR LANDING MISSION

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MSC INTERNAL NOTE NO. 68-FM-266

October 28,1968

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LIGHTING GEOMETRY FOR THE APOLLO C' ALTERNATE 1 MISSION REVISION 1

(This revision supersedes MSC Internal Note No. 68-FM-243 dated October 2, 1968)

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MSC INTERNAL NOTE NO. 68-FM-267

October 28, 1968

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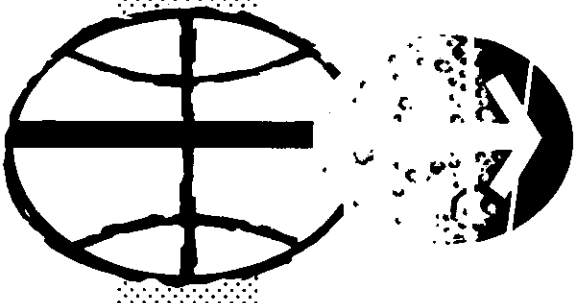

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October 28, 1968

PRELIMINARY LM ABORT AND CSM RESCUE PLAN FOR APOLLO MISSION G

VOLUME I

LM ABORT, CSM RESCUE, AND CSM ASSIST DURING ASCENT AND DESCENT

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MSC INTERNAL NOTE NO. 68-FM-269

OCTOBER 1968

APOLLO MISSION F SPACECRAFT REFERENCE TRAJECTORY

VOLUME I

REFERENCE TRAJECTORY PROFILE (LAUNCHED AUGUST 14, 1969)

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and

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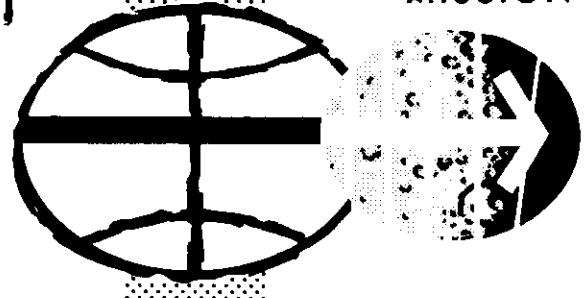
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-270

November 4, 1968

A DESCRIPTION OF THE OUTPUT AND DISPLAYS OF THE APOLLO MISSION PLANNING AND REAL-TIME RENDEZVOUS SUPPORT PROGRAM

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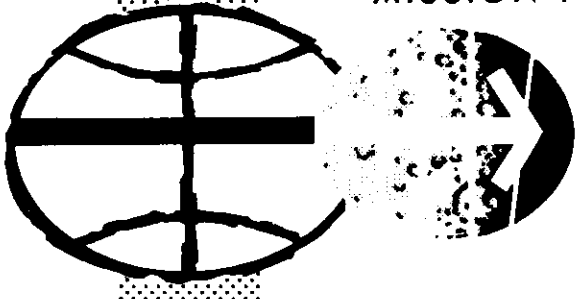

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Memorandum

TO : See List Below

DATE: DEC 1 7 1968

68-FM63-364

FROM : FM6/Orbital Mission Analysis Branch

SUBJECT: Change 1 to the output of the Apollo Mission Planning and Real-Time Rendezvous Support Program

Reference: Kahanek, J. W.: A Description of the Output and Displays of the Apollo Mission Planning and Real-Time Rendezvous Support Program, MSC Internal Note No. 68-FM-270, November 4, 1968.

The enclosed document is change 1 to the referenced internal note. These changes correct typing, output deficiencies, and describe new output of the Apollo Mission Planning and Real-Time Rendezvous Support Program.

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
(See attached list)

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MSC INTERNAL NOTE NO. 68-FM-271

November 25, 1968

RTCC REQUIREMENTS FOR APOLLO 8: PREFLIGHT INFORMATION

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-272

November 8, 1968

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APOLLO MISSION C',

ALTERNATE 1

PRELIMINARY ATTITUDE SEQUENCE

VOLUME II

LUNAR ORBIT

Mission Design Section

TRW Systems Group

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MSC INTERNAL NOTE NO. 68-FM-274

November 14, 1968

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ABORT RESET POINTS FOR AN APOLLO 8 MISSION LAUNCHED DECEMBER 21, 1968

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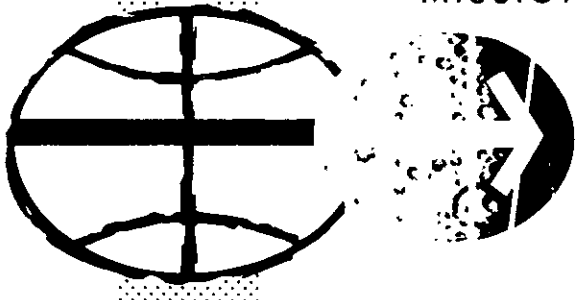

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November 14, 1968

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EFFECTS OF LOCAL TERRAIN PROFILES ON THE NOMINAL LM DESCENT TRAJECTORY

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MSC INTERNAL NOTE NO. 68-FM-277

November 26, 1968

APOLLO 8

SLA PANEL JETTISON SEPARATION AND RECONTACT ANALYSIS FOR LAUNCH PHASE AND ORBITAL ABORTS

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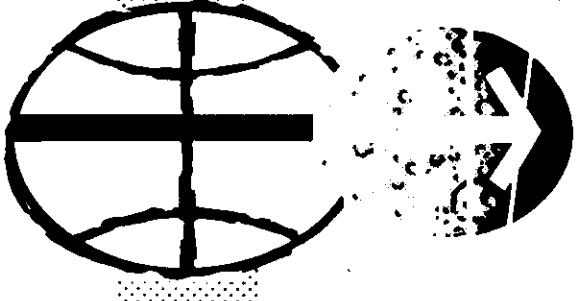
MSC INTERNAL NOTE NO. 68-FM-278

November 18, 1968

CONSUMABLES ANALYSIS FOR THE APOLLO 8 SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-279

November 18, 1968

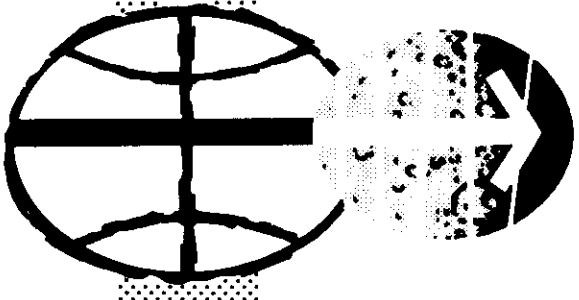
APOLLO 8

MSFN COVERAGE

DURING LUNAR ORBIT PERIODS

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-280

November 21, 1968

APOLLO 8
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VOLUME I
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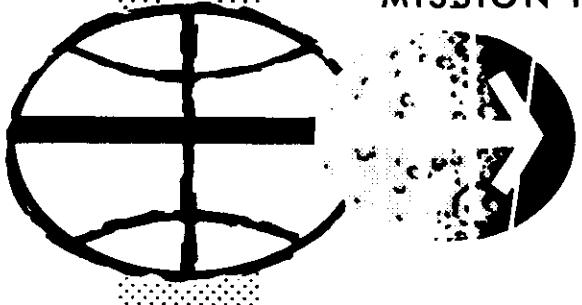
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-281

November 21, 1968

TRANSEARTH FLIGHT TIMES FOR THE APOLLO 8 MISSION

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-282

November 22, 1968

ATTITUDE SEQUENCE FOR THE APOLLO 8 SPACECRAFT OPERATIONAL TRAJECTORY

Lunar Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-283

November 29, 1968

RTCC REQUIREMENTS FOR MISSIONS F AND G: EARTH ORBIT INSERTION PROCESSOR (REVISION I)

(This revision supersedes MSC Internal Note No. 68-FM-69 dated March 14, 1968.)

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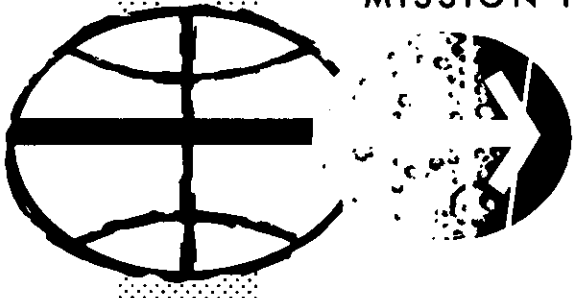

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MSC INTERNAL NOTE NO. 68-FM-257

October 11, 1968

APOLLO POSTFLIGHT TRAJECTORY PARAMETERS

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MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-286

November 29, 1968

APOLLO MISSION D
(AS-504/CSM-104/LM-3) SPACECRAFT
OPERATIONAL TRAJECTORY
VOLUME II - TRAJECTORY DATA
PART 2 - LM AND CSM/LM
SEPARATION PARAMETERS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-287

November 29, 1968

APOLLO MISSION D

(AS-504/CSM-104/LM-3) SPACECRAFT

OPERATIONAL TRAJECTORY

VOLUME III-MSFN TRACKING DATA

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MSC INTERNAL NOTE NO. 68-FM-288

DECEMBER 3, 1968

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ONBOARD MIDCOURSE CORRECTION TARGETING DURING THE TRANSEARTH COAST PHASE OF A LUNAR MISSION

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MSC INTERNAL NOTE NO. 68-FM-289

December 6, 1968

APOLLO 8

MISSION PLANNING BRIEFINGS

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MSC INTERNAL NOTE NO. 68-FM-290

December 5, 1968

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RTCC REQUIREMENTS FOR THE LUNAR LANDING MISSION: A METHOD FOR ADJUSTING THE CSM ORBIT TO ELIMINATE THE DIFFERENCE BETWEEN THE RTCC AND A PRIORI ESTIMATES OF THE LANDING SITE POSITION

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MSC INTERNAL NOTE NO. 68-FM-291

December 9, 1968

LAUNCH WINDOW EFFECTS ON THE APOLLO 8 MISSION OPERATIONAL ABORT PLAN

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-284

December 2, 1968

APOLLO MISSION D
(AS-504/CSM-104/LM-3)
SPACECRAFT OPERATIONAL TRAJECTORY

VOLUME I

MISSION PROFILE

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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Date of Paper: December 16, 1968

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VOLUME II

SUMMARY OF TRANSEARTH TRAJECTORY DATA FOR DECEMBER 1968 LAUNCH WINDOW

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December 9, 1968

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MSC INTERNAL NOTE NO. 68-FM-295

December 11, 1968

APOLLO 8
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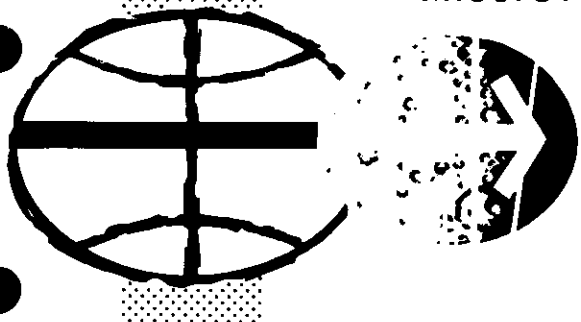

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MSC INTERNAL NOTE NO. 68-FM-296

December 11, 1968

REVISION 1
TO THE CONSUMABLES ANALYSIS FOR THE APOLLO 8 SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch

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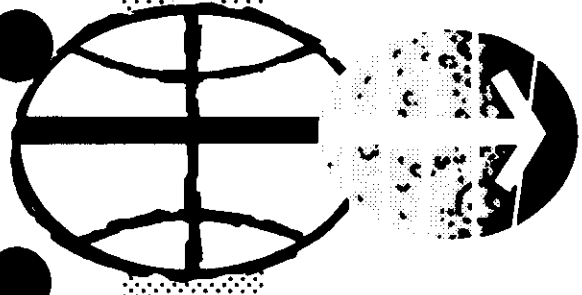

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Date of Paper: **December 16, 1968**

5. Author(s) **Don A. Nelson, Walter Scott, Richard C. Wadle, Sam A. Kamen, Dwight G. Peterson, Richard Svalin, and Cynthia D. Wells**

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December 13, 1968

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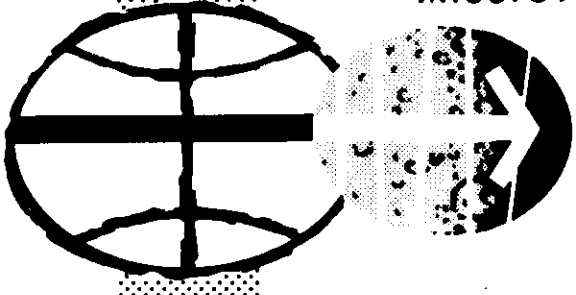

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FOR

MSC INTERNAL NOTE 68-FM-297 DATED DECEMBER 13, 1968

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By Joe W. Nolley
Guidance and Performance Branch

Change 1

February 14, 1969

Marlowe D. Cassetti, Chief
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MSC INTERNAL NOTE NO. 68-FM-298

December 13, 1968

APOLLO 8 SPACECRAFT DISPERSION ANALYSIS

VOLUME I - DISPERSION SUMMARY

Guidance and Performance Branch

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Memorandum

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8 : See attached list

DATE: DEC 18 1968
68-FM7-594

ROM : FM7/Chief, Guidance and Performance Branch

UBJECT: Revision to Volume I of the Apollo 8 Spacecraft Dispersion Analysis

References

1. McHenry, R. L., GPB: Apollo 8 Spacecraft Dispersion Analysis, Volume I - Dispersion Summary. MSC IN 68-FM-298, December 13, 1968.

2. Hitt, G. C.; Kindall, S. M., TRW Systems Group; and Yencharis, J. D., LMAB: Apollo 8 Spacecraft Dispersion Analysis, Volume II - Translunar and Transearth Phases. MSC IN 68-FM-303, December 16, 1968.

As stated in reference 1, subsequent to the completion of the Apollo 8 dispersion analysis it was determined that the magnitude of the spacecraft venting thrust was about three times larger than the worst expected venting. It is now believed that operational procedures that have been developed will minimize the effects of spacecraft venting on the Manned Space Flight Network (MSFN) navigation errors. Hence the information on translunar midcourses in reference 1 and the translunar midcourses containing the effects of venting in reference 2 should be disregarded. The data contained in reference 2 on the translunar mission dispersions without venting should be considered as typical of the results to be expected for the Apollo 8 mission. The following table summarizes the no venting translunar dispersions:

Dispersions	Maneuver			
	MCC-1	MCC-2	MCC-3	MCC-4
Percent SPS maneuvers performed	95	0	0	2.5
SPS ΔV (mean + 3σ), ft/sec	25.91+47.85	0	0	5.99+1.35
Percent RCS maneuvers performed	4	6.5	53.0	93.0
Percent RCS trims performed	78	0	0	2.5
Percent no maneuvers performed	1	93.5	47.0	4.5
RCS ΔV (mean + 3σ), ft/sec	0.63+2.73	1.47+2.76	1.40+2.20	1.69+2.85
Pericynthion altitude (3σ), nautical miles	31.41	25.11	12.96	9.06

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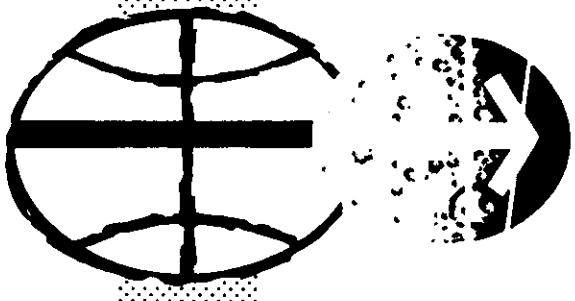
December 18, 1968

APOLLO 6 ENTRY POSTFLIGHT ANALYSIS



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MSC INTERNAL NOTE NO. 68-FM-301

December 18, 1968

APOLLO MISSION D
(AS-504/CSM-104/LM-3)
SPACECRAFT OPERATIONAL TRAJECTORY

VOLUME II
TRAJECTORY DATA

PART 3
FLIGHT CREW SIMULATOR DATA

Flight Analysis Branch and TRW Systems Group

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-302

December 12, 1968

REVISION I TO THE ATTITUDE SEQUENCE FOR THE APOLLO 8 SPACECRAFT OPERATIONAL TRAJECTORY

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MISSION PLANNING AND ANALYSIS DIVISION

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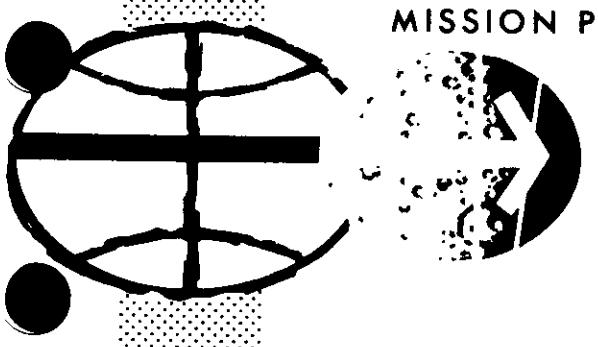
MSC INTERNAL NOTE NO. 68-FM-303

December 16, 1968

APOLLO 8
SPACECRAFT DISPERSION ANALYSIS
VOLUME II
TRANSLUNAR AND TRANSEARTH PHASES

TRW Systems Group
and
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-304

December 13, 1968

REVISION 1
TO THE APOLLO 8 SPACECRAFT OPERATIONAL TRAJECTORY REENTRY PHASE FOR VOLUME I

Landing Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-305

December 16, 1968

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AN ENVELOPE OF SATURN V MALFUNCTION TRAJECTORIES WHICH CAN ACHIEVE ORBIT

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MSC INTERNAL NOTE NO. 68-FM-306

December 16, 1968

REVISED SHIP POSITIONING AND COVERAGE DATA FOR MISSION APOLLO 8 LUNAR LAUNCH OPPORTUNITIES FOR DECEMBER 1968

TRW Systems Group

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-307

December 16, 1968

THE EARTH AND THE MOON AS VIEWED FROM THE SPACECRAFT DURING THE APOLLO 8 MISSION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-309

December 27, 1968

MINIMUM ΔV, TWO- AND THREE-IMPULSE NON-COPLANAR ABORT MANEUVERS ONTO AN ESCAPE ASYMPTOTIC VELOCITY VECTOR FOLLOWING PREMATURE SPS SHUTDOWN DURING LOI PHASE

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

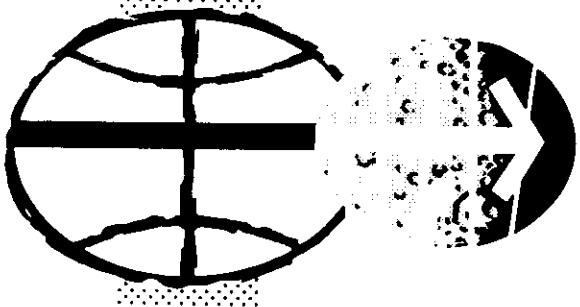
MSC INTERNAL NOTE NO. 68-FM-311

December 19, 1968

MSFN NAVIGATION ERROR ANALYSES FOR THE APOLLO 8 MISSION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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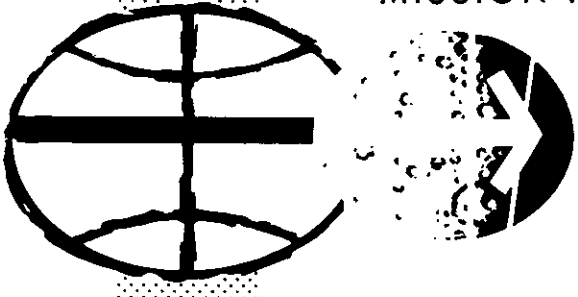
MSC INTERNAL NOTE NO. 68-FM-312

December 30, 1968

PREDICTED LAUNCH ABORT LANDING POINT DATA COMPUTED FOR APOLLO 7

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-292

December 9, 1968

REVISION 1 TO THE APOLLO 8 SPACECRAFT OPERATIONAL TRAJECTORY VOLUME 1 - MISSION PROFILE FOR DECEMBER 21 LAUNCH

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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314

OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : See List Below

DATE: FEB 4 1969
69-FM23-18

FROM : FM2/Landing Analysis Branch

SUBJECT: Modified logic and equations for RTCC computation of lunar landing descent trajectory

This document updates the logic for the RTCC computation of the powered descent trajectory due to recent LUMINARY 1-A program changes approved by the Software Control Board. These changes eliminate linear guidance, pulse-out inhibit and provides for use of radial control whenever quadratic guidance is utilized.

Floyd V. Bennett
Chief, Landing Analysis Branch

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr.
Chief, Flight Software Branch

Addressees: (See attached page)

ORIGINAL DESTROYED

DATE: 5/22/70

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 68-FM-314 DATED DECEMBER 31, 1968

LOGIC AND EQUATIONS FOR RTCC COMPUTATION

OF LUNAR LANDING DESCENT TRAJECTORY

By Edwin G. Dupnick

Change 3

Revised by Richard J. Labrecque

June 17, 1969

Floyd V. Bennett, Chief
Landing Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacements, have been inserted, place this CHANGE SHEET between the cover and title page and write on the cover, "CHANGE 3 inserted".

1. Replace pages 16, 17, and 19.

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MSC INTERNAL NOTE NO. 69-FM-2

January 7, 1969

PREDICTED HORIZONTAL VELOCITY FOR SPACECRAFT LAND LANDINGS CALCULATED DURING THE APOLLO 8 COUNTDOWN DEMONSTRATION TEST

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See attached list

DATE:

File No. 68-FM13-757

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Apollo mission D (AS-504/CSM 104/LM-3) Spacecraft Operational Alternate Mission Plan

The attached document presents the spacecraft operational alternate mission studies for the D mission. It presents the current alternate mission strategy and is meant to supersede a preliminary version of the alternate mission plan, MSC internal note 68-FM-108, published April 15, 1968.

The document has been distributed according to the attached list. Any questions or comments pertaining to the document or its distribution should be referred to this office, extension 4091.

R. P. Parten

APPROVED BY:

John P. Mayer
for Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
(See attached list)

FM13:CWPace:pj

5010-108

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69FM3

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UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See list below

DATE: FEB 2[illegible] 1969
File No. 69-FM13-99

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Additional information pertaining to the Apollo 9 (Mission D) SA 504/CSM 104/LM-3 Spacecraft Operational Alternate Mission Plan (MSC Internal Note 69-FM-3)

The attached enclosures provide additional information pertaining to alternate missions presented in the subject document. Enclosure 1 provides mission timeline information for a CSM alone. The general philosophy used in designing the mission is to maintain nominal ground-tracks, network contacts and daily access to the prime recovery area. By adhering to the nominal sequence, those mission requirements which can be satisfied by the CSM alone will be salvaged.

Enclosure 2 documents a review of the subject document in light of the changes in mission rules and mission requirements that have resulted since publication of the document. As a result of the review, changes in the timelines for general Alternate Missions C, D, and F are recommended.

R. P. Parten

APPROVED BY:

Carl P. Huss

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosures

cc:
CA/D. K. Slayton
CB/J. A. McDivitt
D. R. Scott
R. L. Schweickart
A. B. Shepard
CF34/T. W. Holloway
J. V. Rivers
PA/G. M. Low
K. S. Kleinknecht
C. H. Bolender
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R. L. Kubicki
FC/J. Bostick (10)
FM/J. P. Mayer
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D. H. Owen
R. H. Brown
Branch Chiefs
FM6/T. H. Skopinski
K. Young
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H. Conway
L. Hartley
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5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : See list below

DATE: JAN 15 1969

69-FM51-02

FROM : FM5/Chief, Lunar Miss on Analysis Branch

SUBJECT: RTCC requirement for mission F - translunar midcourse optimum fl by options

The attached document, MSC IN 69-FM-4, defines program logic for three additional options to be added to the current RTCC translunar midcourse processor. The options provide the capability for obtaining fuel critical solutions to either a specified return longitude or to an unspecified earth landing area and also provide for computing flyb solutions from large TLI dispersions.

Ronald L. Berry

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees: (See attached list)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-5

February 7, 1969

REVISION I
TO THE APOLLO MISSION G
SPACECRAFT REFERENCE TRAJECTORY
VOLUME I
REFERENCE MISSION PROFILE
(LAUNCHED AUGUST 14, 1969)

Lunar Mission Analysis Branch, Landing Analysis Branch,

and Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-7

January 10, 1969

APOLLO 9 SPACECRAFT OPERATIONAL DISPERSION ANALYSIS VOLUME IV - NAVIGATIONAL ERROR ANALYSIS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

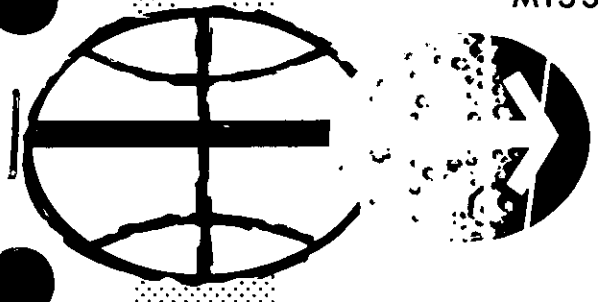
MSC INTERNAL NOTE NO. 69-FM-8

January 15, 1969

THE CONSUMABLES ANALYSIS FOR THE APOLLO 9 SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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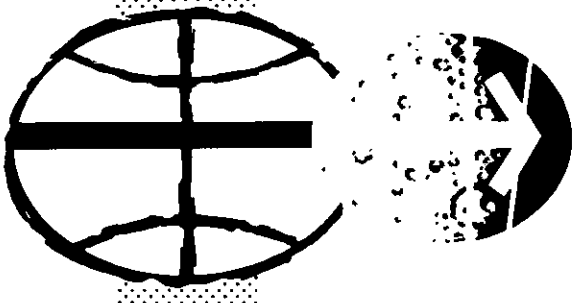
MSC INTERNAL NOTE NO. 69-FM-9

January 16, 1969

PREDICTED HORIZONTAL VELOCITY FOR SPACECRAFT LAND LANDNGS CALCULATED DURING THE APOLLO 8 MISSION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-10

January 17, 1969

APOLLO 9 OPERATIONAL LM ABORT AND RESCUE PLAN

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MAY 1962 EDITION
GSA GEN. REG. NO. 27

5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : See list below

DATE: JAN 17 1969

69-FM51-08

FROM : FM5/Lunar Mission Analysis Branch

SUBJECT: RTCC requirements for mission G - LOI targeting logic

The attached internal note, MSC IN 69-FM-11, defines updated program logic for targeting of the lunar orbit insertion maneuver. The changes or additions to the C' processor include:

a. Change the tolerances ϵ_{CN}, $\epsilon_{1\psi}$, and ϵ_{CNC} to 1.0×10^{-8}, and 0.453786×10^{-3} radians, respectively.

b. Display the minimum ΔV to brake coplanar solution for all LOI plans generated.

c. The preflight data parameter, ΔT_{BIAS} for elliptical lunar parking orbit, in the computation of the time of arrival at the landing site.

The attached internal note also contains logic for correcting the ignition time for transearth injection and the time to first pass over the lunar landing site for varying parking orbit altitudes. This logic is not to be implemented for F but will be considered for a later system.

This IN supersedes IN 68-FM-173.

Ronald L. Berry

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure
Addressees: (See attached list)

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MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See Attached List

DATE: July 25, 1969

FROM : FM5/Chief, Lunar Mission Analysis Branch

69-FM51-209

SUBJECT: RTCC requirements for Mission H-2 - LOI targeting logic

The attached document, MSC Internal Note No. 69-FM-11, defines changes in the formulation for the LOI targeting processors to be incorporated in the RTCC system for H-2.

Ronald L. Berry

Ronald L. Berry

APPROVED BY:

for John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees: (See attached list)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: 70-FM54-58

Feb. 26, 1970

MEMORANDUM TO: See list below

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT : RTCC requirements for Apollo 14 (H-3): LOI targeting processor

The enclosed replacement pages constitute change 2 to MSC Internal Note No. 69-FM-11. When this change is incorporated into the document, that internal note will constitute the detailed RTCC programming requirements for the LOI targeting processor for Apollo 14 (H-3). The replacement pages reflect the following corrections to the logic:

1. Allow rotation of target ellipse both forward and backward in every case.

2. Flight Controller will specify via a MED in which direction the ellipse should be rotated.

3. Miscellaneous corrections to logic.

These change sheets constitute formal documentation of the program changes specified in RTCC Transmittal No. 14411, dated February 5, 1970.

MSC Internal Note No. 69-FM-327, which was published as the LOI targeting requirements for Apollo 14 (H-3), should now be considered as LOI targeting requirements for Apollo 15 (H-4).

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

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MSC INTERNAL NOTE NO. 69-FM-13

January 22, 1969

REENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR MISSION D/CSM-104/LM-3

MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

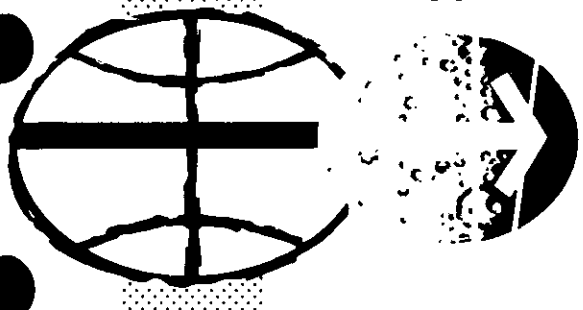
MSC INTERNAL NOTE NO. 69-FM-14

January 23, 1969

EFFECT OF VARIOUS PARAMETERS ON A MANUAL, CONSTANT g REENTRY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-15

January 27, 1969

OPERATIONAL ABORT PLAN FOR THE APOLLO 9 MISSION VOLUME I - LAUNCH PHASE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-16

January 29, 1969

MISSION G REQUIREMENTS FOR THE RTCC: NOMINAL ASCENT AND ABORT FROM DESCENT

(This document supersedes MSC Internal Note No. 68-FM-140 dated June 12, 1968)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-17

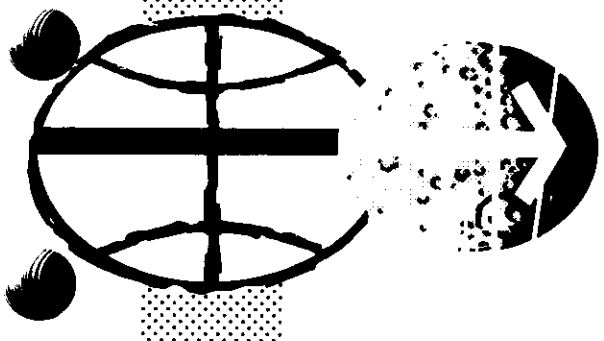
January 31, 1969

REVISION 1 TO THE APOLLO 9 SPACECRAFT OPERATIONAL TRAJECTORY

VOLUME I - MISSION PROFILE

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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UNITED STATES GOVERNMENT

Memorandum

TO : See list below

DATE: 69-FM22-71

FROM : FM2/Chief, Landing Analysis Branch

SUBJECT: RTCC requirements for G Mission: Nominal ascent and abort from descent program logic

References:

1. MSC Internal Note 69-FM-16, "Mission G requirements for the RTCC: Nominal ascent and abort from descent," by Veit Hanssen, dated January 29, 1969.

2. TRW IOC 7332.9-255, "Preliminary FP-X flow charts and constants list," by B. Burkett, dated January 3, 1969.

This memorandum documents changes required in the LM ascent and abort logic for Mission G. The basic logic is documented in reference 1. These changes pertain to the logic which simulates the AGS targeting. Prior to the release of AGS Flight Program X (reference 2), it was assumed that, during each computation cycle, the downrange target velocity, ($\dot{Z}_D$), was computed as a function of phase angle and current altitude. However, FP-X logic used predicted altitude, not current altitude. These changes also show the calculation of the current total acceleration, which was inadvertently omitted in reference 1, and a correction in the sign of the effective gravity calculation.

Floyd V. Bennett

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr.
Chief, Flight Software Branch

Enclosure

5010-106

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 69-FM-16 DATED JANUARY 29, 1969

MISSION G REQUIREMENTS FOR THE RTCC:

NOMINAL ASCENT AND ABORT FROM DESCENT

By Veit Hanssen

Change 2

By Charles Halliman and Ernest M. Fridge

August 5, 1969

Floyd V. Bennett, Chief
Landing Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

Page 1 of 5
(with enclosures)

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NOTE: A black bar in the margin indicates the area of change.

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MSC INTERNAL NOTE NO. 69-FM-20

January 30, 1969

PRELIMINARY LUNAR DESCENT DISPERSION ANALYSIS

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-21

January 30, 1969

WEIGHTING STRUCTURE AND NAVIGATIONAL PROFILE STUDY RESULTS FOR EARTH ORBIT LANDMARK NAVIGATION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-22

January 31, 1969

ENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR LUNAR RETURN TRAJECTORIES

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MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-314

December 31, 1968

LOGIC AND EQUATIONS FOR RTCC COMPUTATION OF LUNAR LANDING DESCENT TRAJECTORY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-24

JANUARY 29, 1969

REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 8 OPERATIONAL SUPPORT TEAM HANDBOOK

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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MSC INTERNAL NOTE NO. 69-FM-25

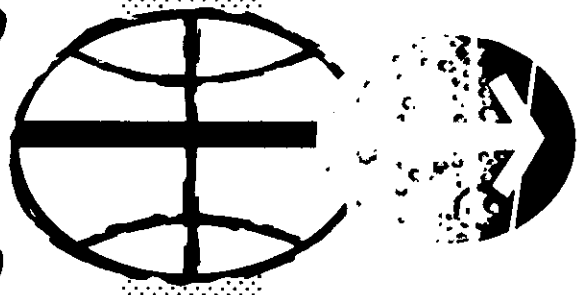
February 3, 1969

PRELIMINARY ALTERNATE MISSION PLAN FOR APOLLO MISSION

VOLUME I - EARTH ORBIT

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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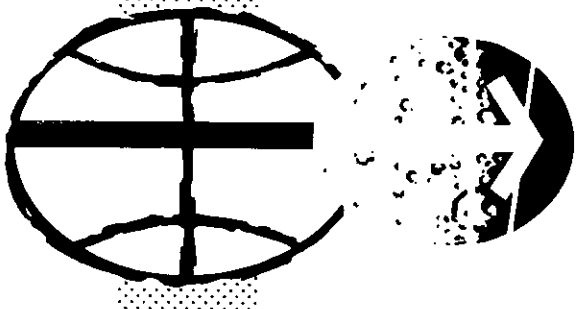
MSC INTERNAL NOTE NO. 69-FM-26

February 6, 1969

OPTIMUM MULTI-IMPULSE RENDEZVOUS TRAJECTORIES BETWEEN TIME-COUPLED STATES

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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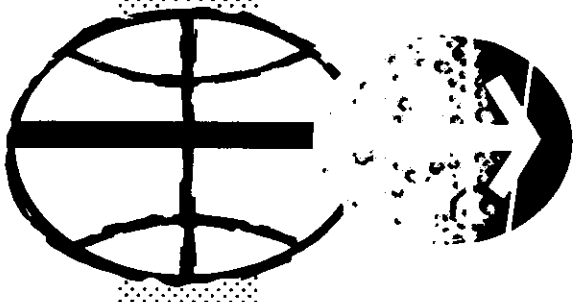
MSC INTERNAL NOTE NO. 69-FM-27

January 28, 1969

PRELIMINARY APOLLO MISSION F TRAJECTORY DATA FOR THE MAY 1969 LAUNCH WINDOW

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-28

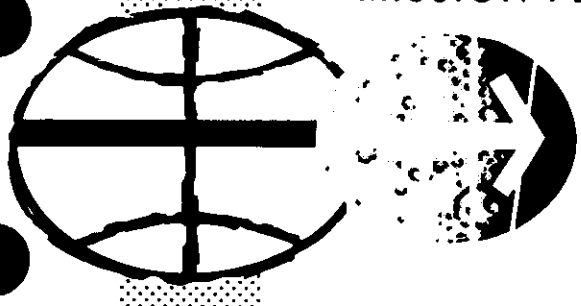
February 6, 1969

RTCC REQUIREMENTS FOR MISSIONS F AND G: REENTRY PHASE

(This revision supersedes MSC Internal Note 68-FM-216 dated August 30, 1968)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: MAR 1 0 1969

69-FM23-52

FROM : FM2/Landing Analysis Branch

SUBJECT: RTCC Requirements: Recommended changes to the RTCC reentry subsystem to prevent computer interrupts for Mission G

Reference: MSC Internal Note No. 69-FM-28, "RTCC Requirements for Missions F and G Reentry Phase," by J. W. Tolin, J. K. Burton, and J. E. Rogers, dated February 6, 1969.

This memorandum recommends additional logic necessary to protect against obtaining computer interrupts in the RTCC reentry subsystem. These interrupts are possible during the simulation of the onboard guidance equations presented in the reference.

In particular, it is possible to obtain interrupts caused by negative square root functions in the following calculations shown in the reference:

1. The "VL" calculation on page 31 of the reference.
2. The "E" calculation on page 32 of the reference.
3. The "VREF" calculation on page 34 of the reference.

In addition, an interrupt is also possible in evaluating a negative $\log_e$ in the "ASPUP" calculation on page 32 of the reference.

To prevent the occurrance of said interrupts, it is recommended that just prior to the indicated calculations of "VL," "E," "VREF," and "ASPUP," that the respective arguments using the square root function or the $\log_e$ function be checked for being negative. If any of the arguments are negative the program should be changed to immediately exit such by a branch to flow chart location "380" on page 38 of the reference.

5010-108

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MSC INTERNAL NOTE NO. 69-FM-29

February 7, 1969

RTACF WORK SCHEDULE PLOTS FOR APOLLO 9

(This revision supersedes MSC Internal Note No. 68-FM-238 dated September 24, 1968)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-30

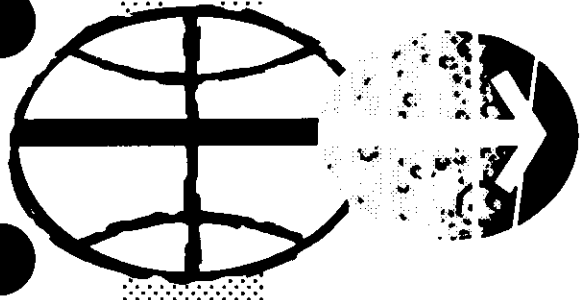
January 31, 1969

APOLLO MISSION F

MISSION PLANNING BRIEFING

FOR THE CREW

MISSION PLANNING AND ANALYSIS DIVISION



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MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : See list below

DATE: 1969

69-FM61-23

FROM : FM6/Chief, Orbital Mission Analysis Branch

SUBJECT: Transmittal of detailed programming requirements

The enclosed MSC Internal Note No. 69-FM-31 presents detailed requirements for the real-time computer program to be employed in support of the Apollo missions beginning with the lunar landing mission. This document supersedes the previous internal note of the same title, no. 68-FM-5, January 5, 1968.

Edgar C. Lineberry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:
See attached list

5010-106

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NASA - Manned Spacecraft Center

RELEASE APPROVAL

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69-FM-31 Dated February 10, 1969

Page 1 of 1 Pages

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Branch **Orbital Mission Analysis**
Section

4. Title or Subject **LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF THE LUNAR MODULE LAUNCH WINDOW AND RECOMMENDED LIFT-OFF TIME**

Date of Paper
August 25, 1969

5. Author(s)
W. A. Sullivan

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MSC INTERNAL NOTE NO. 69-FM-32

February 10, 1969

COMPARISON OF 10-MINUTE AND ONE-PASS ORBITAL FITS FOR A NEAR-CIRCULAR LUNAR ORBIT

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-33

February 12, 1969

RTCC REQUIREMENTS FOR MISSION F: LUNAR FLYBY MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

(This revision supersedes MSC Internal Note No. 69-FM-4 dated January 9, 1969)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-34

February 11, 1969

PRELIMINARY LM ABORT AND RESCUE PROCEDURES FOR APOLLO MISSION F

VOLUME I

NONTIME-CRITICAL PROCEDURES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-35

February 17, 1969

APOLLO 9 SPACECRAFT DISPERSION ANALYSIS VOLUME II RENDEZVOUS DISPERSION ANALYSIS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-37

February 13, 1969

OPERATIONAL ABORT PLAN FOR THE APOLLO 9 MISSION VOLUME II CONTINGENCY DEORBIT

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MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-38

February 17, 1969

PRELIMINARY ALTERNATE MISSION PLAN FOR APOLLO MISSION F

VOLUME II

ALTERNATE LUNAR MISSIONS

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-39

February 19, 1969

PRELIMINARY LM ABORT AND CSM RESCUE PLAN FOR APOLLO MISSION G

VOLUME II

RENDEZVOUS FOLLOWING ANYTIME LM LIFT-OFF

MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-40

February 17, 1969

REVISION 1
TO THE CONSUMABLES ANALYSIS FOR THE APOLLO 9 SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-41

March 7, 1969

APOLLO MISSION F
(AS-505/CSM-106/LM-4)
SPACECRAFT OPERATIONAL TRAJECTORY
VOLUME II
TRAJECTORY DATA
PART 3 - FLIGHT CREW SIMULATOR DATA

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-42

February 19, 1969

APOLLO 9 SPACECRAFT

OPERATIONAL DISPERSION ANALYSIS

VOLUME I

DISPERSION ANALYSIS SUMMARY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-43

February 24, 1969

APOLLO 9 SLA PANEL JETTISON SEPARATION AND RECONTACT ANALYSIS

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MSC INTERNAL NOTE NO. 69-FM-44

February 24, 1969

APOLLO 9 SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

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MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-45

February 20, 1969

REVISION 2
TO THE APOLLO 9 SPACECRAFT
OPERATIONAL TRAJECTORY
VOLUME I
MISSION PROFILE

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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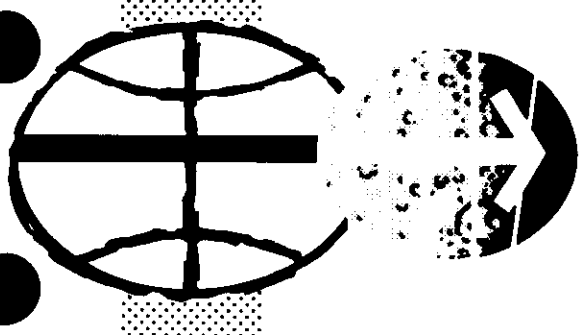
MSC INTERNAL NOTE NO. 69-FM-23

January 31, 1969

PRELIMINARY LM ABORT AND CSM RESCUE PLAN FOR APOLLO MISSION G

VOLUME IV

ABORTS FROM POWERED DESCENT



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MSC INTERNAL NOTE NO. 69-FM-47

FEBUARY 17, 1969

REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 9 OPERATIONAL SUPPORT TEAM HANDBOOK

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 69-FM-49

FEBRUARY 17, 1969

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 9 FLIGHT ANNEX

FLIGHT ANALYSIS BRANCH

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MSC INTERNAL NOTE NO. 69-FM-50

February 25, 1969

REVISION 2

TO THE CONSUMABLES ANALYSIS FOR THE APOLLO 9 SPACECRAFT OPERATIONAL TRAJECTORY

Guidance And Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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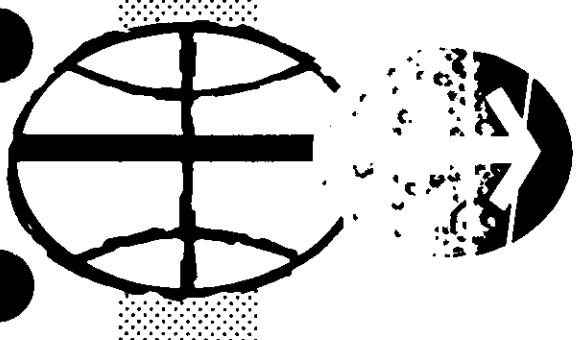
MSC INTERNAL NOTE NO. 69-FM-51

FEBRUARY 21, 1969

PRELIMINARY LUNAR ORBIT ATTITUDE SEQUENCE FOR MISSION F



LUNAR MISSION ANALYSIS BRANCH
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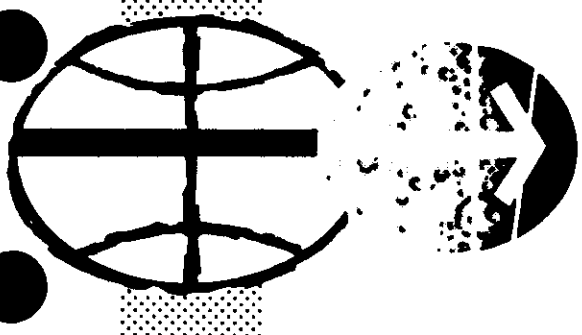
MSC INTERNAL NOTE NO. 69-FM-53

March 3, 1969

USERS' MANUAL FOR THE APOLLO GUIDANCE ANALYSIS STATISTICAL TRIALS PROGRAM

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-54

February 28, 1969

APOLLO 9 MONITORING ANALYSIS FOR EACH POWERED MANEUVER

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MISSION PLANNING AND ANALYSIS DIVISION

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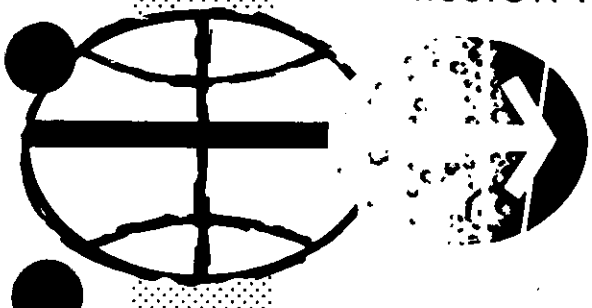
MSC INTERNAL NOTE NO. 69-FM-55

February 28, 1969

RTCC REQUIREMENTS FOR MISSION G: NONFREE-RETURN MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-56

March 3, 1969

TLI SHIP POSITIONING AND COVERAGE DATA FOR APOLLO MISSION F LUNAR LAUNCH OPPORTUNITIES FOR MAY 1969

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MSC INTERNAL NOTE NO. 69-FM-57

March 4, 1969

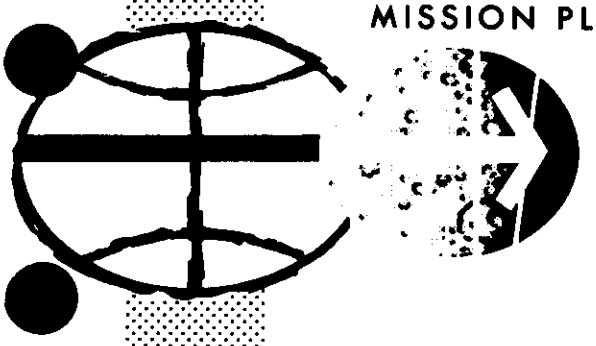
PRELIMINARY ALTERNATE MISSION PLAN FOR APOLLO MISSION F

VOLUME III

LUNAR ALTERNATE RENDEZVOUS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-58

March 7, 1969

REVISION 2

RTCC REQUIREMENTS FOR MISSIONS F AND G: EARTH ORBIT INSERTION PROCESSOR

(This revision supersedes MSC Internal Note No. 68-FM-283 dated November 29, 1968.)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-59

February 28, 1969

APOLLO 9

MISSION CREW CHARTS

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-60

March 10, 1969

DESCENT/ASCENT MONTE CARLO PROGRAM (DAMP) MODIFICATIONS IN SUPPORT OF DESCENT/ASCENT ONBOARD/GROUND MONITORING PROCEDURES ANALYSIS

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-61

March 10, 1969

PRELIMINARY ABORT AND RESCUE PROCEDURES FOR APOLLO MISSION F

VOLUME III

TIME-CRITICAL PROCEDURES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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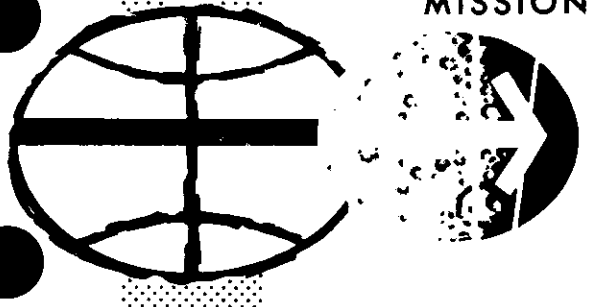
MSC INTERNAL NOTE NO. 69-FM- 62

March 11, 1969

LINEARIZED IMPULSIVE EARTH APPROACH GUIDANCE ANALYSIS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-63

March 17, 1969

EVALUATION OF STEEP FINAL APPROACH PHASE LUNAR DESCENT TRAJECTORIES

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-64

March 13, 1969

BRIEFING CHARTS FOR LUNAR ORBIT NAVIGATION PROBLEM, FOR LM DESCENT, AND FOR HYBRID MISSION

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-65

March 26, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO MISSION F VOLUME I - OPERATIONAL MISSION PROFILE LAUNCHED MAY 17, 1969

Orbital Mission Analysis Branch,
Lunar Mission Analysis Branch,
and
Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-66

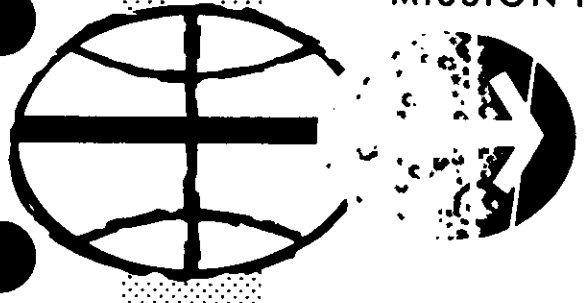
March 10, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO MISSION F

VOLUME II-OPERATIONAL MISSION PROFILE TRAJECTORY PARAMETERS, LAUNCHED MAY 17, 1969

Orbital Mission Analysis Branch,
Lunar Mission Analysis Branch
and
Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-46

February 25, 1969

PLANNED RENDEZVOUS TECHNIQUE FOLLOWING LM ABORT FROM POWERED DESCENT

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-70

March 21, 1969

DEORBIT AND ENTRY CREW TRAINING SIMULATIONS FOR NEAR-EARTH ORBITAL MISSIONS

MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 69-FM-71

March 21, 1969

ABORT RESET POINTS FOR APOLLO 10 (MISSION F)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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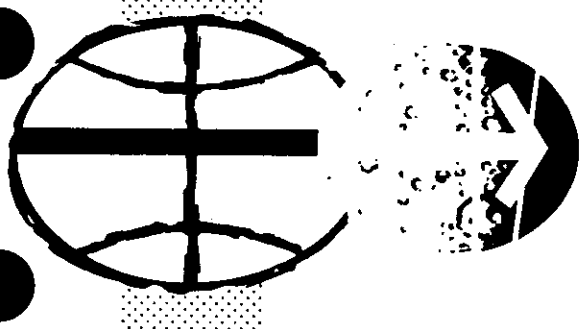
MSC INTERNAL NOTE NO. 69-FM-72

March 26, 1969

PRELAUNCH GO/NO-GO COMPUTATIONS FOR THE APOLLO 9 MISSION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

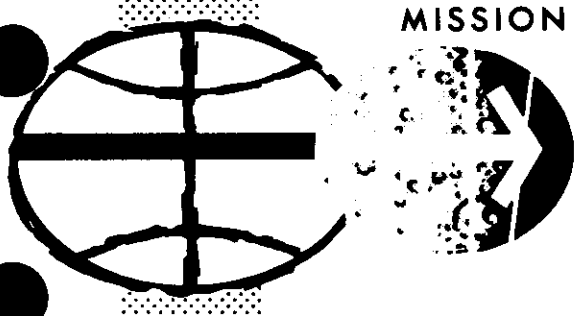
MSC INTERNAL NOTE NO. 69-FM-73

May 9, 1969

GUIDANCE ANALYSIS OF AERODYNAMIC PHASE OF DESCENT TO THE SURFACE OF MARS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-74

March 21, 1969

VIEWS FROM THE SPACECRAFT DURING APOLLO 10 (MISSION F)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-75

March 21, 1969

PRELIMINARY APOLLO MISSION G TRAJECTORY DATA FOR THE JULY 1969 LAUNCH WINDOW

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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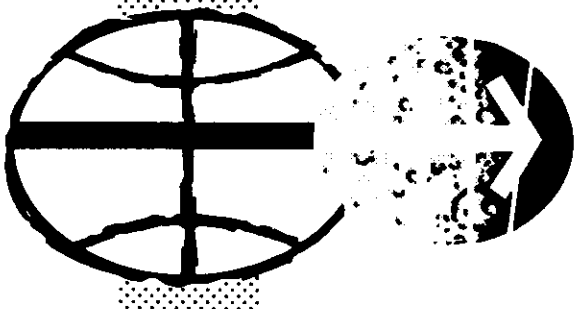
MSC INTERNAL NOTE NO. 69-FM-76

April 7, 1969

CONSUMABLES ANALYSIS FOR THE APOLLO 10 (MISSION F) SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-77

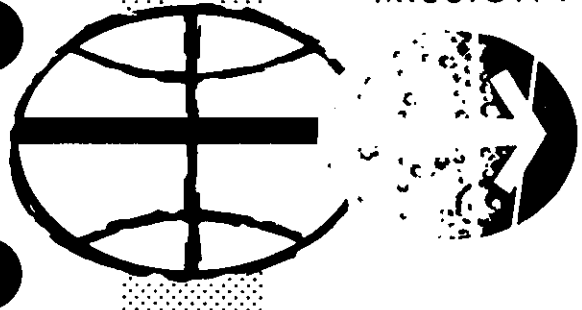
March 28, 1969

APOLLO MISSION G

MISSION PLANNING BRIEFING

FOR THE CREW

MISSION PLANNING AND ANALYSIS DIVISION



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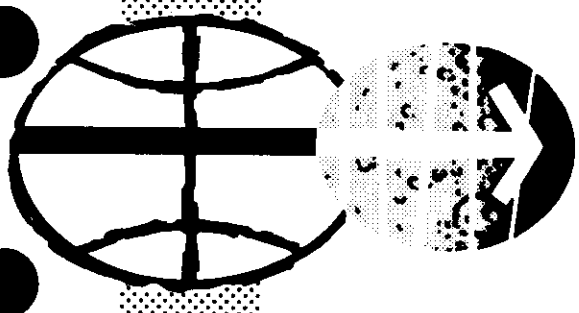
MSC INTERNAL NOTE NO. 69-FM-78

APRIL 9, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 10 (MISSION F)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-80

April 7, 1969

RTCC REQUIREMENTS FOR APOLLO 10 (MISSION F) PREFLIGHT INFORMATION

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NASA - Manned Spacecraft Center

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1. Type of Document: Change sheet to Internal Note

2. Identification: [illegible] dated April [illegible], 1969

Page 1 of 1 Pages

TO:

3. FROM:
Division: Mission Planning and Analysis
Branch: Lunar Mission Analysis
Section:

4. Title or Subject: PTCC REQUIREMENTS FOR APOLLO 10 ('ISSION F) PREFLIGHT INFORMATION

Date of Paper: April 16, 1969

5. Author(s): Roger P. Duncan

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-81

April 11, 1969

LUNAR LANDMARK TRACKING ATTITUDE STUDIES

LUNAR MISSION ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See List Below

DATE: JUL 2 9 1969
69-FM47-250

FROM : FM/Mission Planning and Analysis Division

SUBJECT: Change Sheet for MSC Internal Note No. 69-FM-81

1. Reference: MSC Internal Note No. 69-FM-81, "Lunar Landmark Tracking Attitude Studies," C. R. Hunt, TRW Systems, April 11, 1969.

2. The Apollo command module sextant and scanning telescope coverage with the LM attached defined in figures 2 and 3, respectively, have been slightly modified. Figures 1 and 4 of the attached illustrates how the revised coverages have been changed from those defined in the reference. Figures 2 and 3 of the attached illustrate the revised coverages as they should appear in the reference, and these should replace the present figures 2 and 3 of this internal note.

3. The revised coverages will not alter the tracking attitude of any of the three modes described in the reference.

James C. McPherson, Chief
Mathematical Physics Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Attachment

Distribution: (See attached list)

FM4:TJBlucker:rmr

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MSC INTERNAL NOTE NO. 69-FM-82

April 10, 1969

APOLLO 10 (MISSION F) SPACECRAFT OPERATIONAL ALTERNATE MISSION PLANS

VOLUME I

EARTH ORBITAL ALTERNATES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-83

APRIL 14, 1969

APOLLO 10 (MISSION F)
(AS-505/CSM 106/LM-4)
SPACECRAFT DISPERSION ANALYSIS
VOLUME I
NAVIGATION ERROR ANALYSIS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-84

April 10, 1969

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 10 (MISSION F)

VOLUME I
NONTIME-CRITICAL PROCEDURES

Orbital Mission Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-85

April 9, 1969

APOLLO 10 (MISSION F) SPACECRAFT OPERATIONAL ALTERNATE MISSION PLANS

VOLUME III
LUNAR ALTERNATE RENDEZVOUS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-86

April 14, 1969

HIGH-SPEED ENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR APOLLO 10 (MISSION F)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-87

April 14, 1969

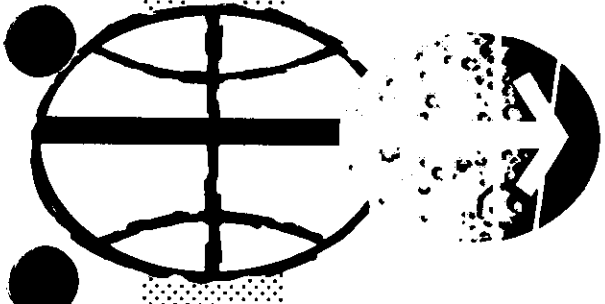
APOLLO 10 (MISSION F)

SPACECRAFT OPERATIONAL ALTERNATE MISSION PLANS

VOLUME II

ALTERNATE LUNAR MISSIONS

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-88

April 18, 1969

APOLLO 9 POSTJETTISON SEPARATION MANEUVER FOR THE APS BURN TO DEPLETION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-89

May 26, 1969

APOLLO 7 ENTRY POSTFLIGHT ANALYSIS

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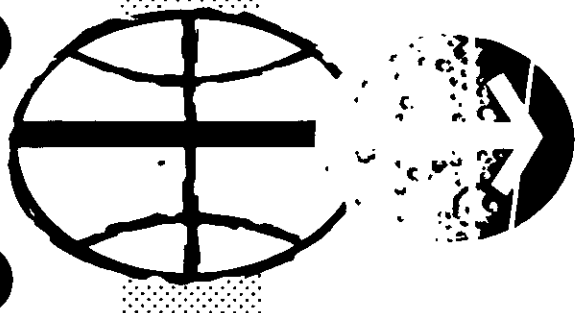
MSC INTERNAL NOTE NO. 69-FM-90

May 14, 1969

LAUNCH WINDOW EFFECTS ON THE APOLLO 10 (MISSION F) OPERATIONAL ABORT PLANS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-91

April 18, 1969

A DESCRIPTION OF THE INPUT TO THE APOLLO MISSION PLANNING AND REAL-TIME RENDEZVOUS SUPPORT PROGRAM

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-67

March 26, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO MISSION F VOLUME III - MISSION SUMMARIES: MAY 1969 LAUNCH WINDOW

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-93

April 24, 1969

APOLLO 10 (MISSION F)

RTACF DATA BANK FORMAT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-94

June 6, 1969

A MINIMUM ΔV, ONE-IMPULSE ORBIT TRANSFER PROBLEM SOLVED BY THE METHOD OF LAGRANGE MULTIPLIERS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-95

April 25, 1969

REVISION 1
TO THE USERS' MANUAL FOR THE APOLLO GUIDANCE ANALYSIS STATISTICAL TRIALS PROGRAM

(This document supersedes MSC Internal Note No. 69-FM-53 dated March 3, 1969)

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE HISTORY FOR 69-FM-95

Change no.	Date	Description
1	5-20-69	Replace page 25: clarification of tailoff phase time. Replace page 40: capability added to discontinue monitoring of a computer in the middle of a profile; added a rendezvous radar data display event. Replace page 41: capability added to perform vector transfers of the actual state vector; added new options to the time flag ITEV. Replace page 43: new option added to the out-of-plane velocity nulling flag IPN. Replace page 46: event time source table updated. Replace pages 60 and 61 and add 61A: capability added to perform automatic vector replacements through the IUPDATE flag; page added to allow for the length of the IUPDATE flag definitions. Replace page 62: updated LCODE input for landmark tracking.

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CHANGE HISTORY FOR 69-FM-95

Change no.	Date	Description
1	5-20-69	Replace page 25: clarification of tailoff phase time. Replace page 40: capability added to discontinue monitoring of a computer in the middle of a profile; added a rendezvous radar data display event. Replace page 41: capability added to perform vector transfers of the actual state vector; added new options to the time flag ITEV. Replace page 43: new option added to the out-of-plane velocity nulling flag IPN. Replace page 46: event time source table updated. Replace pages 60 and 61 and add 61A: capability added to perform automatic vector replacements through the IUPDATE flag; page added to allow for the length of the IUPDATE flag definitions. Replace page 62: updated LCODE input for landmark tracking.
2	6-23-69	Replace page 6: added the LM insertion corrective maneuver and AGS ascent to maneuver capabilities. Replace page 11 and add page 11a: added a generalized matrix input format. Replace pages 12, 14, 15, 16 and add pages 16a, 16b: added lunar potential model and random number control flags; added lift-off time input and the capability to input an RTCC vector package.

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 69-FM-95 DATED APRIL 25, 1969

REVISION 1

TO THE USERS' MANUAL FOR THE

APOLLO GUIDANCE ANALYSIS

STATISTICAL TRIALS PROGRAM

By Dennis M. Braley

Change 3

November 10, 1969

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

NOTE: A black bar in the margin indicates the areas of change.

After the attached enclosures, which are replacements, have been inserted and the pen and ink changes listed below have been made, place this CHANGE SHEET between the cover and title page and write on the cover "CHANGE 3 inserted".

1. Prior to section 3 on page 15, insert "sections 3 through 5 are included only if IORB $\neq$ 2".

2. The last sentence in the definition of the vector on page 16a should start "if ISET $\neq$ 2, the vector is on one card".

3. The insertion prior to section 6 on page 16a should be changed to read "Sections 6 through 8 are included only if IORB $\neq$ 1".

4. The variable in section 7 (page 18) should read "DXA(LM)" instead of "CSA(LM)".

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 69-FM-95 DATED APRIL 25, 1969

REVISION 1 TO THE USERS' MANUAL FOR THE

APOLLO GUIDANCE ANALYSIS STATISTICAL

TRIALS PROGRAM

By Dennis M. Braley

Change 4

April 6, 1970

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

NOTE: A black bar in the margin indicates the area of change.

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1. Replace pages 34, 37, 39, 45, 46, 47, 51, 52, 55a, and 57.

2. Add page 46a.

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MSC INTERNAL NOTE NO. 69-FM-96

April 28, 1969

REVISION I OF THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 10 (MISSION F)

VOLUME I
OPERATIONAL MISSION PROFILE
LAUNCHED MAY 18, 1969

Lunar Mission Analysis Branch,
Landing Analysis Branch,
and
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-97

April 28, 1969

REVISION I OF THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 10 (MISSION F)

VOLUME II
OPERATIONAL MISSION PROFILE TRAJECTORY PARAMETERS LAUNCHED MAY 18, 1969

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Landing Analysis Branch,
and
Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-98

May 16, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR MISSION G
VOLUME I
OPERATIONAL MISSION PROFILE, LAUNCHED JULY 16, 1969

Lunar Mission Analysis Branch,
Landing Analysis Branch,
and
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-92

May 29, 1969

RTCC REQUIREMENTS FOR MISSION G: LANDING SITE DETERMINATION USING RENDEZVOUS RADAR AND OPTICAL OBSERVATIONS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-100

May 15, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR MISSION G VOLUME III MISSION SUMMARIES: JULY 1969 LAUNCH WINDOW

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MSC INTERNAL NOTE NO. 69-FM-103

June 13, 1969

PRELIMINARY LUNAR ORBIT ATTITUDE SEQUENCE FOR MISSION G

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-104

May 23, 1969

TLI SHIP POSITIONING AND COVERAGE DATA FOR MISSION G (APOLLO 11) LUNAR LAUNCH OPPORTUNITIES FOR JULY, AUGUST, AND SEPTEMBER 1969

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See attached list

DATE: MAY 21 1969

File No. 69-FM13-290

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Apollo 11 (G) Mission Operational Consumables Analysis

The attached document presents the Consumables Analysis for the Apollo 11 (G) Mission Operational Trajectory. It is a complete update to and replaces the Reference Trajectory Consumables Analysis (68-FM-246). The results were obtained from detailed analyses performed on the RCS, SPS, APS, DPS, ECS and EPS.

The Apollo 11 Preliminary Flight Plan, dated April 15, 1969, included the preliminary results of the Operational Consumables Analysis. Therefore, the attached document will serve as an update to the consumables data published in the Preliminary Flight Plan. The revised Operational Consumables Analysis is scheduled for June 1969.

R. P. Parten

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
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(Distribution "D")

FM13:JRGurley:lg

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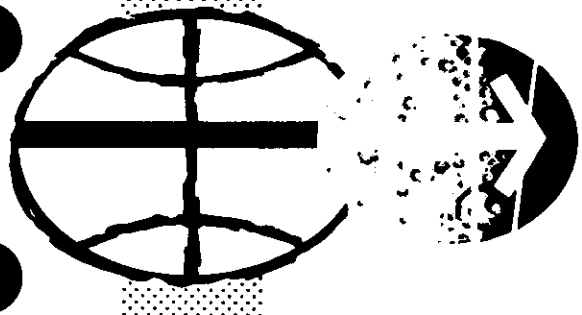
MSC INTERNAL NOTE NO. 69-FM-107

April 22, 1969

VIEWS FROM THE SPACECRAFT DURING APOLLO 10 (MISSION F) MAY 18, 1969 LAUNCH DATE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-108

April 29, 1969

ENGINEERING NOMOGRAPH SHOWING CRATER VISIBILITY DURING LUNAR MODULE DESCENT

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-109

April 24, 1969

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THE EFFECTS OF TLI MALFUNCTIONS ON MISSION F CREW MONITORING PROCEDURES

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-99

May 8, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR MISSION G

VOLUME II

OPERATIONAL MISSION PROFILE TRAJECTORY PARAMETERS, LAUNCHED JULY 16, 1969

Lunar Mission Analysis Branch,
Orbital Mission Analysis Branch,
and
Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-113

OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR MISSION F

April 23, 1969

LUNAR MISSION ANALYSIS BRANCH
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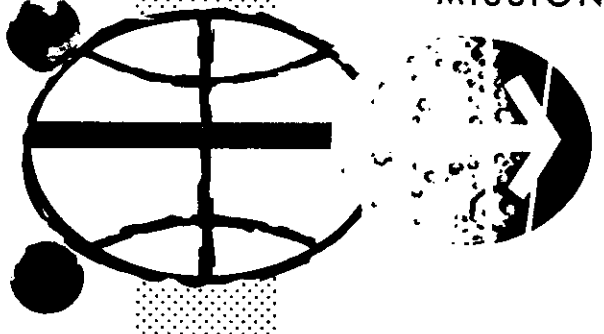
MSC INTERNAL NOTE NO. 69-FM-114

May 1, 1969

LM DESCENT TRAJECTORY CONSTRAINTS IMPOSED BY CRATER VISIBILITY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISON



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MSC INTERNAL NOTE NO. 69-FM-115

April 28, 1969

APOLLO 10 (MISSION F)
MISSION PLANNING BRIEFINGS

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MSC INTERNAL NOTE NO. 69-FM-116

April 30, 1969

VISUAL REPRESENTATION OF THE ABORT RESET POINTS FOR APOLLO 10 (MISSION F)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-117

May 6, 1969

APOLLO 8
RTACF POSTMISSION REPORT

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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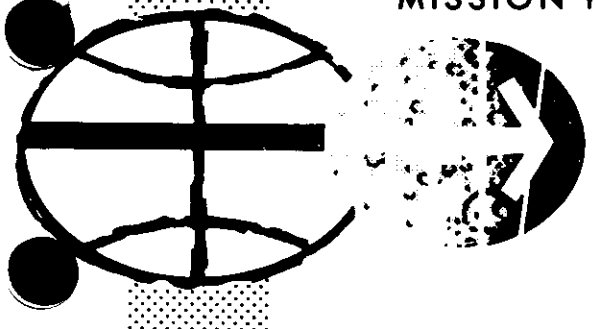
MSC INTERNAL NOTE NO. 69-FM-118

May 9, 1969

COMPARISON OF THE CREW OPTICAL ALINEMENT SIGHT DEVICE AND THE SEXTANT DURING A TYPICAL RENDEZVOUS SEQUENCE

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-119

May 12, 1969

RATIONALE FOR USING THE SATURN MONITOR AND ABORT CREW CHARTS FOR APOLLO 10 (MISSION F)

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-120

June 13, 1969

EVASIVE MANEUVER SUBSEQUENT TO CSM/LM EJECTION FROM THE S-IVB IN EARTH ORBIT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-121

May 2, 1969

APOLLO 10 (MISSION F) OPERATIONS REVIEW PRESENTED AT MSC ON APRIL 29, 1969

MISSION PLANNING AND ANALYSIS DIVISION

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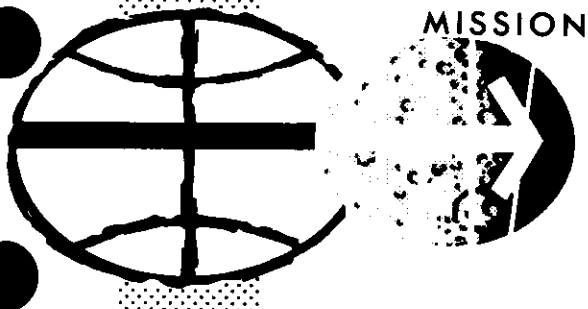
MSC INTERNAL NOTE NO. 69-FM-122

May 13, 1969

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 10 TRAJECTORY SUPPORT CHIEFS PROCEDURES HANDBOOK

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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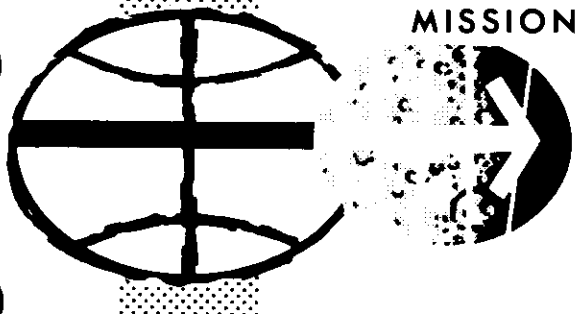
MSC INTERNAL NOTE NO. 69-FM-123

May 13, 1969

APOLLO 10 SPACECRAFT DISPERSION ANALYSIS VOLUME V G&N LANDING ERROR DISPERSIONS

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-124

June 9, 1969

POSTFLIGHT EVALUATION OF THE APOLLO 8 EVASIVE MANEUVERS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-125

May 13,1969

APOLLO 10 SPACECRAFT DISPERSION ANALYSIS VOLUME III LOI, TEI, AND APS BURN-TO-DEPLETION MANEUVERS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-126

May 9, 1969

REVISION 1 TO THE CONSUMABLES ANALYSIS FOR THE APOLLO 10 (MISSION F) SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-127

May 12, 1969

APOLLO 10 (MISSION F) VEHICLE AND TRAJECTORY RESPONSE TO THE CSM POWERED FLIGHT MANEUVERS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-128

May 12,1969

APOLLO 10 (MISSION F) VEHICLE AND TRAJECTORY RESPONSE TO THE LM POWERED FLIGHT MANEUVERS

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MSC INTERNAL NOTE NO. 69-FM-129

May 12, 1969

VERIFICATION OF THE RTCC POWERED FLIGHT SIMULATION FOR APOLLO 10 (MISSION F)

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISON

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-130

May 28, 1969

ENTRY MISSION PLAN

APOLLO 8 SUMMARY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-131

May 12, 1969

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 10 FLIGHT ANNEX

FLIGHT ANALYSIS BRANCH

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-110

April 24, 1969

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 10 (MISSION F)

SUPPLEMENT TO

VOLUME I

NON-TIME-CRITICAL PROCEDURES SPECIFIC CASE DATA

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-133

May 16, 1969

CHANGES TO THE DKI LOGIC FOR APOLLO MISSION G AND SUBSEQUENT MISSIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-134

May 12, 1969

SPS ΔV REQUIREMENTS FOR THE APOLLO 10 (MISSION F) MAY AND JUNE LAUNCH WINDOWS

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-135

May 13, 1969

REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 10 OPERATIONAL SUPPORT TEAM HANDBOOK

FLIGHT ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 69-FM-136

May 13, 1969

APOLLO 10 (MISSION F)
CREW CHARTS

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-137

May 12, 1969

APOLLO MISSION F
(AS-505/CSM-106/LM-4) SPACECRAFT OPERATIONAL TRAJECTORY, REVISION1
VOLUME II
TRAJECTORY DATA
PART 3
FLIGHT CREW SIMULATOR DATA

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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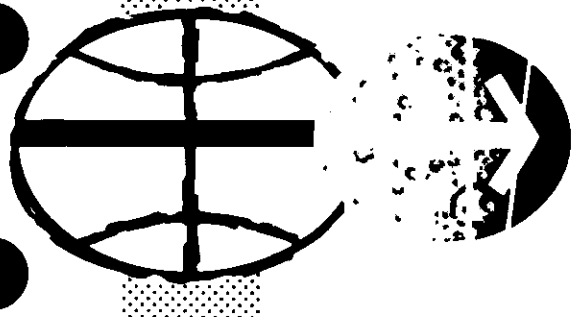
MSC INTERNAL NOTE NO. 69-FM-138

May 14, 1969

APOLLO 10 (MISSION F)
(AS-505/CSM-106/LM-4)
SPACECRAFT DISPERSION ANALYSIS
ADDENDUM TO VOLUME 1
NAVIGATION ERROR ANALYSIS



Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION
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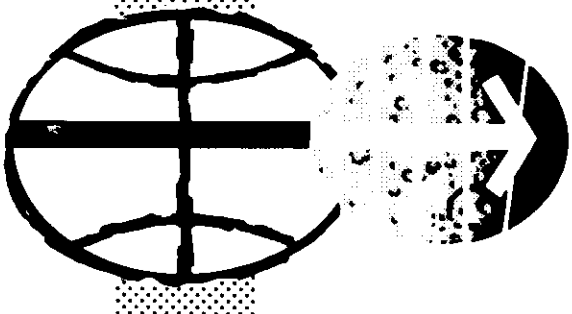
MSC INTERNAL NOTE NO. 69-FM-139

MAY 14, 1969

PROJECT APOLLO

APOLLO 10 SPACECRAFT DISPERSION ANALYSIS VOLUME IV RENDEZVOUS DISPERSION ANALYSIS



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MSC INTERNAL NOTE NO. 69-FM-140

May 14, 1969

RTACF WORK SCHEDULE FOR APOLLO 10

FLIGHT ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-141

May 14, 1969

SEPARATION PROCEDURES FOR APOLLO 10 NOMINAL, ALTERNATE, AND ABORT MISSIONS

FLIGHT ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-142

May 14, 1969

APOLLO 10 SPACECRAFT DISPERSION ANALYSIS

VOLUME II

TRANSLUNAR AND TRANSEARTH PHASES

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-143

May 13, 1969

APOLLO 10 SPACECRAFT DISPERSION ANALYSIS

VOLUME VI

DISPERSION SUMMARY

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-144

May 15, 1969

APOLLO 10 SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO 69-FM-145

May 15, 1969

CISLUNAR NAVIGATION SIGHTING DATA FOR THE APOLLO 10 MISSION: MAY 1969 LAUNCH WINDOW

Mathmatical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

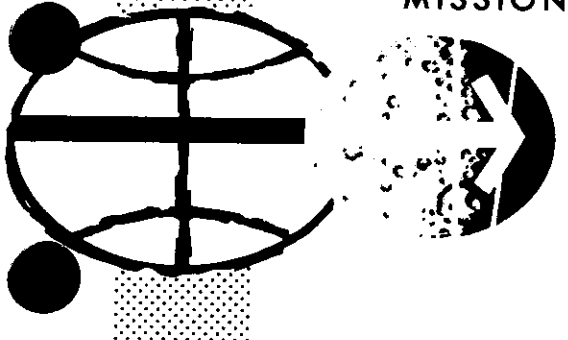
MSC INTERNAL NOTE NO. 69-FM-146

May 15, 1969

REENTRY TRAJECTORY CONTROL USING THE ENTRY MONITORING SYSTEM

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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CHANGE SHEET FOR

INTERNAL NOTE 69-FM-146 DATED MAY 15, 1969

REENTRY TRAJECTORY CONTROL USING

THE ENTRY MONITORING SYSTEM

By Ross Ferland and Robert Edwards

Change 1

May 16, 1969

Floyd V. Bennett, Chief
Landing Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

After the following replacement pages have been inserted, place this change sheet between the cover and title page and write on the cover, "CHANGE 1 inserted".

1. Due to poor reproduction, replacement copies of figure 1(a) through 1(l) are enclosed.

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MSC INTERNAL NOTE NO. 69-FM-147

June 13, 1969

APOLLO 9 RTACF POSTMISSION REPORT

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MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-148

May 29, 1969

NUMERICALLY INTEGRATED EVALUATION OF EARTH'S PERTURBATION EFFECTS ON THE LIFETIME OF A LUNAR SATELLITE AT A 660-N. MI. ALTITUDE AND WITH A 120° INCLINATION

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-149

June 2, 1969

AN EMPIRICAL TECHNIQUE FOR COMPUTING NAVIGATION COVARIANCE MATRICES AND THE APPLICATION OF THE TECHNIQUE TO POST APOLLO 8 LUNAR ORBIT MISSION PLANNING

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-150

June 19, 1969

PREDICTED LAUNCH ABORT LANDING POINT DATA COMPUTED FOR APOLLO 10

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-151

June 3, 1969

AN ANALYTIC METHOD FOR COMPUTING THE STATE TRANSITION MATRIX WHICH INCORPORATES THE SECULAR AND PERIODIC PERTURBATIONS OF THE SECOND HARMONIC (J_{20}) OF PLANET OBLATENESS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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[illegible]

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-152

June 3, 1969

DEFINITION OF THE RTCC ASCENT PREDICTOR MONITORING LIMITS FOR PGNCS TO AGS SWITCHOVER DURING LM POWERED ASCENT

Guidance Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-153

June 3, 1969

APOLLO 10
TRANSEARTH COMMUNICATION
LOSS PROCEDURES

MATHEMATICAL PHYSICS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-154

JUNE 3, 1969

QUICKEST POSSIBLE RETURNS TO EARTH FOR APOLLO 11 (MISSION G) ABORTS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See list below

DATE: MAY 13 1969

69-FM51-128

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT: RTCC requirements for Mission G: EOI polynomials

The attached internal note, 69-FM-13?, reflects a change in the EOI polynomials due to early S-II cutoff, a recent change in the Saturn thrust profile. Although the change affects both the F and G mission, it has been agreed that no change will be made in the RTCC F system.

Ronald L. Berry

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees: (See attached list)

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UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See attached list

DATE: JUN 5 1969

File No. 69-FM13-311

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Apollo 11 Lunar Descent Dispersion Analysis

The Apollo 11 Spacecraft Dispersion Analysis, Volume IV, Part 1--Lunar Descent Dispersion Analysis is attached. Part 2, Lunar Ascent Dispersion Analysis will be distributed at a later date. This attached document replaces the Preliminary Descent Dispersion Analysis documented in MSC I.N. 69-FM-20. Updates have been made to the descent targeting philosophy, navigation accuracies, lunar potential model, landing radar model and DPS engine model.

Descent engine buildup and tailoff effects have not been included. An update to the attached document is planned in order to include these effects.

The remaining volumes of the Spacecraft Dispersion Analysis series are nearing completion, and they are expected to be distributed by July 1, 1969.

R. P. Parten

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
(See attached list)
(Distribution "D")

FM13:JRGurley:lg

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CHANGE HISTORY FOR 69-FM-156

Change no.	Date	Description
1	6/17/69	Replace pages 7 and 8. The effects of thrust decay have been added to the program and the ΔV residuals calculated.

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CHANGE HISTORY FOR 69-FM-156

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Change no.	Date	Description
1	6/17/69	Replace pages 7 and 8. The effects of thrust decay have been added to the program and the ΔV residuals calculated.

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MSC INTERNAL NOTE NO. 69-FM-158

June 9, 1969

PRELAUNCH GO/NO-GO COMPUTATIONS FOR THE APOLLO 10 MISSION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-159

June 9, 1969

ABORT RESET POINTS FOR

APOLLO 11 (MISSION G)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-160

June 9, 1969

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REVISION 1 TO THE ERROR SOURCE DATA FOR DISPERSION ANALYSES

(This revision supersedes MSC Internal Note No. 68-FM-297 dated December 13, 1968.)

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-161

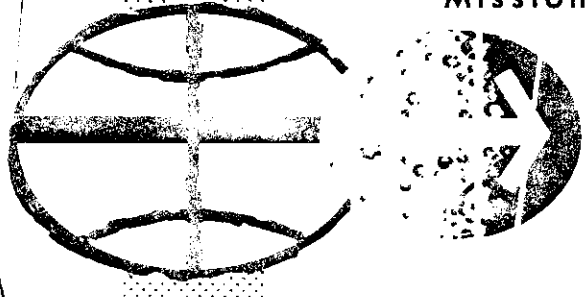
June 13, 1969

AN EFFICIENT METHOD FOR CARTESIAN TRANSFORMATIONS

Mathematical Physics Branch

Mission Planning and Analysis Division

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS



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UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See attached list

DATE: JUN 16 1969

File No. 69-FM13-332

FROM : FM13/Chief, Mission Planning Support Office

SUBJECT: Apollo 11 Operational Abort Plan

The attached document presents the results of detailed spacecraft abort trajectory studies for the Apollo 11 Mission. The data enclosed can be used to determine when the limiting flight dynamics for safe abort are reached, to determine which abort mode or technique is required, and to determine the information on the abort result. The data presented demonstrates that an adequate return-to-earth abort plan exists for all phases of this mission.

This document does not include data for contingencies that require LM rescue or contingency rendezvous. The aforementioned data can be found in the Operational LM Abort and Rescue Plan.

The attached document is based on a launch vehicle operational trajectory which was documented on April 25, 1969. This launch vehicle trajectory does not reflect early center engine shutdown in the S-II stage. The attached document presents comparisons of input data (V_I, γ_I, h etc.) between the final F Mission launch vehicle operational trajectory and the G Mission launch vehicle trajectory dated April 25. The revised G Mission launch vehicle trajectory has just been received and will be used to update the Mode I aborts, the MCC-H plotboards and the crew charts. This update will change only the launch aborts in the attached report. It is not planned to revise the attached document since the launch aborts are but a small part of the document and will be updated by memorandum.

Please direct any questions concerning this document to the Mission Planning Support Office, extension 4091.

R. P. Parten

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees:
(See attached list)
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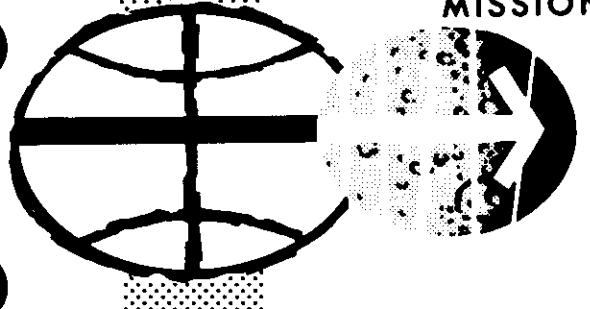
MSC INTERNAL NOTE NO. 69-FM-163

June 16, 1969

AUTONOMOUS NAVIGATION IN LONG-DURATION HIGHLY ECCENTRIC ORBITS ABOUT MARS

Advanced Mission Design Branch
MISSION PLANNING AND ANALYSIS DIVISION



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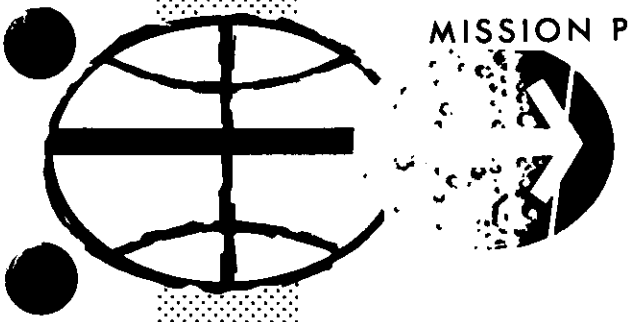
MSC INTERNAL NOTE NO. 69-FM-165

June 16, 1969

AN ANALYSIS OF THE PERFORMANCE CAPABILITY AND VEHICLE DYNAMICS OF THE SATURN V LAUNCH VEHICLE FOR TWO-ENGINE-OUT MALFUNCTIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-166

June 20, 1969

APOLLO 11 (MISSION G) DISPERSION ANALYSIS

VOLUME IV

DESCENT AND ASCENT DISPERSION ANALYSES

PART 2-LUNAR ASCENT

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE HISTORY FOR 69-FM-166

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Change no.	Date	Description
1	7/3/69	Replace pages 1, 12, 13, 15, 16, 17, 20, 74, 75, 76, 77, 78, 79, and 80. This change updates the dispersions in burn time, weight, and propellants as a result of including actual LM 5 weights, C. G. position, APS and RCS data in a 100 case Monte Carlo analysis of the lunar ascent phase of Apollo 11 (Mission G).

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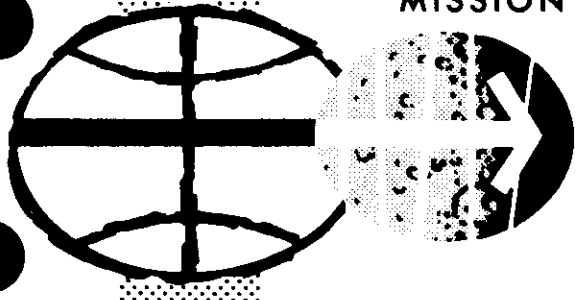
MSC INTERNAL NOTE NO. 69-FM-167

June 19, 1969

A CLOSED-FORM SOLUTION FOR MINIMUM-FUEL, CONSTANT-THRUST TRAJECTORIES

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-168

June 12, 1969

VIEWS FROM THE CM AND LM DURING THE FLIGHT OF APOLLO 11 (MISSION G)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-169

August 25, 1969

PERFORMANCE CAPABILITIES FOR A LUNAR LANDING MISSION TO ARISTARCHUS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-170

June 20, 1969

APOLLO 11

(MISSION G)

SPACECRAFT DISPERSION ANALYSIS

VOLUME VI

ENTRY PHASE

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-171

June 24, 1969

RTCC REQUIREMENTS FOR APOLLO 11 (MISSION G) PREFLIGHT INFORMATION

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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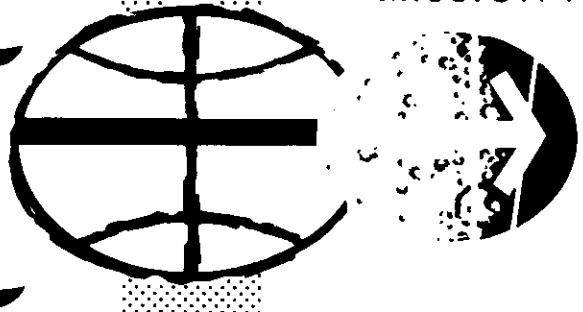
MSC INTERNAL NOTE NO. 69-FM-172

June 24, 1969

LAUNCH WINDOW EFFECTS ON THE APOLLO 11 (MISSION G) OPERATIONAL ABORT PLAN

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NO. 69-FM-155

June 9, 1969

HELIOCENTRIC ABORT ΔV REQUIREMENTS FOR 1977 THROUGH 1986 MARS CONJUNCTION-CLASS MISSIONS

Advanced Mission Design Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-174

June 24, 1969

APOLLO 11 (MISSION G) SPACECRAFT DISPERSION ANALYSIS

VOLUME III

LOI-1, LOI-2, PLANE CHANGE, AND TEI DISPERSIONS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-175

June 27, 1969

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 11 (MISSION G) VOLUME II RENDEZVOUS AND RESCUE

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-176

July 3, 1969

CISLUNAR NAVIGATION SIGHTING DATA FOR APOLLO 11 (MISSION G): JULY 16, 1969, LAUNCH

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-177

June 30, 1969

A PERFORMANCE STUDY OF THE ENTRY GUIDANCE LOGIC FOR ENTRY INTERFACE VELOCITIES OF 25 600 FPS, 25 800 FPS, AND 26 000 FPS AND FOR LIFT-TO-DRAG RATIO FROM 0.1000 TO 0.2000

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-178

June 30, 1969

HYBRID MISSION EFFECTS ON THE LOI PHASE OF THE APOLLO 11 (MISSION G) ABORT PLAN

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-179

July 3, 1969

RTCC REQUIREMENTS FOR MISSION H AND SUBSEQUENT MISSIONS: REENTRY PHASE

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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Mission Planning & Analysis Division

TO : See list below

DATE: AUG 27 1969

69-FM23-224

FROM : FM2/Landing Analysis Branch

SUBJECT: Correction to RTCC requirements for Mission H, reentry phase

Reference: MSC Internal Note 69-FM-179, "RTCC Requirements for Mission H and Subsequent Missions: Reentry Phase," by J. W. Tolin, J. K. Burton, and J. E. Rogers, dated July 3, 1969.

The enclosed change should be incorporated into the above referenced internal note.

Floyd V. Bennett

for John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr.
Chief, Flight Software Branch

Enclosure

Addressees:
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MSC INTERNAL NOTE NO. 69-FM-180

July 1, 1969

APOLLO 11 (MISSION G) SPACECRAFT DISPERSION ANALYSIS VOLUME II TRANSLUNAR AND TRANSEARTH PHASES

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-181

July 1, 1969

AN EVALUATION OF THE LOI ATTITUDE MONITORING PROCEDURE TECHNIQUE FOR DISPERSED TRANSLUNAR APPROACH HYPERBOLAS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-182

June 26, 1969

APOLLO 11 (MISSION G)
MISSION PLANNING BRIEFINGS

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-183

July 2, 1969

ONBOARD NAVIGATION ACCURACIES FOR THE APOLLO 11 (MISSION G) RENDEZVOUS

Mathmatical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-184

JUNE 30, 1969

APOLLO 11 (MISSION G)
SPACECRAFT DISPERSION ANALYSIS
VOLUME V
RENDEZVOUS DISPERSION ANALYSIS

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 69-FM-185

July 2, 1969

RECOMMENDED ENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR APOLLO 11 (MISSION G)

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 69-FM-186

July 3, 1969

REVISION 1 TO THE SPACECRAFT OPERATIONAL TRAJECTORY FOR MISSION G (APOLLO 11)

VOLUME I

OPERATIONAL MISSION PROFILE, LAUNCHED JULY 16, 1969

Lunar Mission Analysis Branch, Landing Analysis Branch,

and Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

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DATE July 9, 1969

MISSION: Apollo 11 (Mission G)

DOCUMENT: MSC IN 69-FM-186

TITLE: Revision 1 to the Spacecraft Operational Trajectory for Mission G (Apollo 11) Volume I - Operational Mission Profile, Launched July 16, 1969

AMENDMENT 1

SHORT TITLE OF CHANGE: Corrections and additions.

CHANGE DESCRIPTION: Insert replacement and additional pages indicated on the attached list.

APPROVED BY: Ronald L. Berry
Ronald L. Berry, Chief
Lunar Mission Analysis Branch

Floyd Bennett
Floyd V. Bennett, Chief
Landing Analysis Branch

Edgar C. Lineberry
Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

for Carl R. Huss
John P. Mayer, Chief
Mission Planning and Analysis Division

MSC FORM 295 (JULY 1969) OT

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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

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DATE July 15, 1969

4. MISSION: Apollo 11 (Mission G)

DOCUMENT: MSC IN 69-FM-186

TITLE: Revision 1 to the Spacecraft Operational Trajectory for Mission G (Apollo 11) Volume I - Operational Mission Profile.

AMENDMENT 2

SHORT TITLE OF CHANGE: Corrections and additions.

CHANGE DESCRIPTION: Insert replacement pages indicated on the attached list.

APPROVED BY:

Ronald L. Berry, Chief
Lunar Mission Analysis Branch

Floyd V. Bennett, Chief
Landing Analysis Branch

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John A. Mayer, Chief
Mission Planning and Analysis Division

MSC FORM 295 (JULY 1969) OT

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MSC INTERNAL NOTE NO. 69-FM-187

July 3, 1969

ENTRY MISSION PLAN APOLLO 11
(MISSION G)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-188

July 3, 1969

OPERATIONAL LM ABORT AND CSM RESCUE PLAN FOR APOLLO 11 (MISSION G) VOLUME I ABORTS FROM POWERED DESCENT AND ASCENT

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-173

June 24, 1969

APOLLO 11 (MISSION G)
(AS-506/CSM 107/LM-5)
SPACECRAFT DISPERSION ANALYSIS
VOLUME I
NAVIGATION ERROR ANALYSIS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See list below

DATE: JUN 30 1969
File No. 69-FM13-367

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Updates to Apollo 11 (Mission G) Crew Charts

Reference is made to MSC Internal Note No. 69-FM-190, "Apollo 11 (Mission G) Crew Charts and Console Charts," by the Mission Planning Support Office, Data Management Group, dated June 27, 1969.

The purpose of this memorandum is to provide the enclosed page changes to the above Internal Note. The changes are as follows:

Crew Chart 10	- Page 17
Crew Chart 11	- Page 18
Crew Chart 19	- Page 27
Crew Chart 20	- Page 28
Crew Chart 21	- Page 29
Crew Chart 24	- Page 32
Crew Chart 25	- Page 33
Crew Chart 26	- Page 34
Crew Chart 27	- Page 35
Crew Chart 28	- Page 36
Crew Chart 29	- Page 37
Crew Chart 30	- Page 38
Crew Chart 31	- Page 39
Crew Chart 32	- Page 40
Crew Chart 33	- Page 41
LM Crew Chart 6	- Page 47

Any questions concerning the enclosed charts should be directed to Mike Collins or Buck Simms at HU3-4907.

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

RPP

Enclosure

Addressees:
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UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

: See list below

DATE: July 3, 1969
File No. 69-FM13-378

: FM13/Mission Planning Support Office
Data Management Group

:T: Updates to Apollo 11 (Mission G) Crew Charts

Reference is made to MSC Internal Note No. 69-FM-190, "Apollo 11 (Mission G) Crew Charts and Console Charts," by the Mission Planning Support Office, Data Management Group, dated June 27, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as updates to the above referenced Internal Note. The changes are as follows:

Crew Chart 12-----Star availability and sighting schedule for an abort from lunar orbit for a launch on July 16, 1969, (TEI to TEI plus 40 hours) by C. Denham, (Mathematical Physics Branch) page 19

Crew Chart 22-----Star availability and sighting schedule for an abort from lunar orbit for a launch on July 18, 1969, (TEI to TEI plus 40 hours) by C. Denham, page 30

Crew Chart 27-----Star availability and sighting schedule for an abort from lunar orbit before noon, G.m.t., July 27, for a launch on July 21, 1969, (TEI to TEI plus 40 hours, lunar horizons) C. Denham page 35

Crew Chart 31-----Star availability and sighting schedule for an abort from lunar orbit after noon, G.m.t., July 27, for a launch on July 21, 1969, (TEI to TEI plus 40 hours, lunar horizons) by C. Denham page 39

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

RPP

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Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

TO : See list below

DATE: JUL 2 1969

File No. 69-FM13-376

FROM : FM13/Mission Planning Support Office

SUBJECT: Updates to Apollo 11 (Mission G) Crew Charts

Reference is made to MSC Internal Note 69-FM-190, "Apollo 11 (Mission G) Crew Charts and Console Charts," by the Mission Planning Support Office, Data Management Group, dated June 27, 1969.

The purpose of this memorandum is to provide the enclosed crew chart updates to Part I of the above referenced Internal Note. The updates are as follows:

Crew Chart 19 --- Perilune Attitude Checks at PDI by E. Dupnick (Landing Analysis Branch) page 27

Crew Chart 34 --- Pre-entry Attitude Timeline by J. Harpold (Landing Analysis Branch) page 56A

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

for RPP

Enclosures

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NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

: See list below

DATE: JUL 11 1969

File No. 69-FM13-396

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Revision 4 to Apollo 11 (Mission G) Crew Charts

Reference is made to MSC Internal Note 69-FM-190, "Apollo 11 (Mission G) Crew Charts and Console Charts," by the Mission Planning Support Office, Data Management Group, dated June 27, 1969.

The purpose of this memorandum is to provide the enclosed chart as an addition to Part I of the above referenced internal note. The revision, which has been forwarded to FCSD at KSC to be incorporated into the onboard data file, is as follows:

> Crew Chart 2A....Cutoff velocities recommended for manual S-IVB shutdowns for off-nominal altitudes at earth orbit insertion. E. M. Henderson (Flight Analysis Branch), page 4A.

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

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Mission Planning & Analysis Division

TO : See list below

DATE: JUL 1 4 1969

File No. 69-FM13-401

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Revision 5 to Apollo 11 (Mission G) Crew Charts

Reference is made to MSC Internal Note 69-FM-190, "Apollo 11 (Mission G) Crew Charts and Console Charts," by the Mission Planning Support Office, Data Management Group, dated June 27, 1969.

The purpose of this memorandum is to provide the enclosed crew charts and console charts as updates to the above referenced internal note. The updates are as follows:

Part I

Crew Chart 2--Listing of planned launch trajectory parameters by E. M. Henderson (Flight Analysis Branch), page 4.

Crew Chart 35--PTC-REFSMMAT in preferred location based on MPAD Spacecraft Operational Trajectory, Rev. 1, page 56B.

Crew Chart 36-- TLI-burn out +1 min. state vector based on MPAD S/C O.T., Rev. 1, page 56C.

Crew Chart 37--Pre-TEI state vector based on MPAD S/C O.T., Rev. 1, page 56D.

Crew Chart 38--TEI-burn out + 1 min. state vector based on MPAD S/C O.T., Rev. 1, page 56E.

Part II

Console Chart 9--Descent oxygen tank quantities as a function of mission time by R. Swalin (Guidance & Performance Branch) page 66.

Console Chart 10--Ascent oxygen tank quantities as a function of mission time by R. Swalin (Guidance & Performance Branch) page 67.

Console Chart 11-Descent water tank quantities as a function of mission time by R. Swalin (GPB) page 68.

Console Chart 12--Ascent water tank quantities as a function of mission time by. R. Swalin (GPB) page 69.

Michael A. Collins, Jr.

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Memorandum

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Mission Planning & Analysis Division

: See list below

DATE: JUL 17 1969

File No. 69-FM13-409

M : FM13/Mission Planning Support Office
Data Management Group

JECT: Revision 6 to Apollo 11 (Mission G) Crew Charts

Reference is made to MSC Internal Note 69-FM-190, "Apollo 11 (Mission G) Crew Charts and Console Charts," by the Mission Planning Support Office, Data Management Group, dated June 27, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as updates to Part I of the above referenced internal note. The updates, which have been forwarded to Mr. Duane Mosel, FCSD at KSC, on July 11, 1969, to be incorporated into the onboard data file, are as follows:

CSM Crew Chart 17--Comparison between the LM and CSM solutions for CSI maneuver as a function of abort time in powered descent. J. Bell, OMAB, page 25.

LM Crew Chart 4--Comparison between the LM and CSM solutions for CSI maneuver as a function of abort time in powered descent. J. Bell, OMAB, page 45.

LM Crew Chart 5--Comparison between the LM and CSM solutions for CDH maneuver as a function of abort time in powered descent--first PDI opportunity (assuming CSM performs CSI). J. Bell, OMAB, page 46.

LM Crew Chart 6--Comparison between the LM and CSM solutions for CDH maneuver as a function of abort time in powered descent--second PDI opportunity (assuming CSM performs CSI). J. Bell, OMAB, page 47.

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

for RPP

Enclosure

Addressees: (See attached list)

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MSC INTERNAL NOTE NO. 69-FM-191

July 3, 1969

REVISION 1 TO THE CONSUMABLES ANALYSIS FOR THE APOLLO 11 (MISSION G) SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
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DATE July 15, 1969

MISSION: Apollo 11

DOCUMENT: MSC IN 69-FM-191

TITLE: REVISION 1 TO THE CONSUMABLES ANALYSIS FOR THE APOLLO 11 (MISSION G) SPACECRAFT OPERATIONAL TRAJECTORY

AMENDMENT 1

SHORT TITLE OF CHANGE: Corrections

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Guidance and Performance Branch

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Mission Planning and Analysis Division

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MSC INTERNAL NOTE NO. 69-FM-192

July 2, 1969

REVISION 1 TO THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 11 (MISSION G) VOLUMNE II OPERATIONAL MISSION PROFILE TRAJECTORY PARAMETERS, LAUNCHED JULY 16, 1969

Lunar Mission Analysis Branch,
Orbital Mission Analysis Branch,
and
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MISSION PLANNING AND ANALYSIS DIVISION

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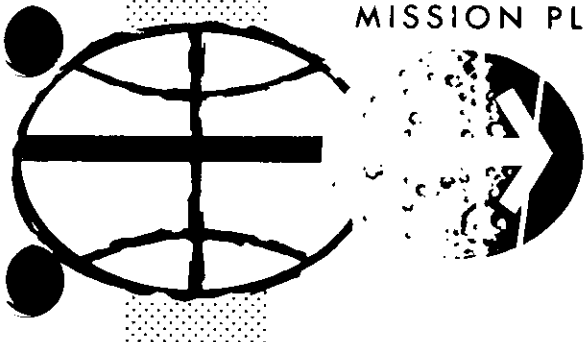
MSC INTERNAL NOTE NO. 69-FM-193

July 7, 1969

RATIONALE FOR USING THE SATURN MONITOR AND ABORT CREW CHARTS FOR APOLLO 11 (MISSION G)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-194

July 7, 1969

GROUND MONITORING OF GUIDANCE VELOCITY RESIDUALS DURING POWERED DESCENT

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-195

July 8,1969

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APOLLO 11

(MISSION G)

ALTERNATE MISSION PLAN

Lunar Mission Analysis Branch

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69- FM- 196

JULY 8, 1969

REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 11 OPERATIONAL SUPPORT TEAM HANDBOOK

FLIGHT ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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MSC INTERNAL NOTE NO. 69-FM-190

June 27, 1969

APOLLO 11 (MISSION G) CREW CHARTS AND CONSOLE CHARTS

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

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JUNE 30, 1969

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 11 FLIGHT ANNEX

FLIGHT ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
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MSC INTERNAL NOTE NO. 69-FM-199

July 7, 1969

RTCC REQUIREMENTS FOR APOLLO 11 (MISSION G) LUNAR FLYBY MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-200

July 7, 1969

APOLLO 11 (MISSION G) SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

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MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-201

July 8, 1969

APOLLO 11 (MISSION G) SPACECRAFT DISPERSION ANALYSIS VOLUME VII

DISPERSION SUMMARY

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MSC INTERNAL NOTE NO. 69-FM-202

July 8, 1969

OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR MISSION G

LUNAR MISSION ANALYSIS BRANCH
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MSC IN 69-FM-202

RECORD OF AMENDMENTS

AMENDMENT NO.	DESCRIPTION	DATE
1	Page 47: At 98:48:10 g.e.t., the pitch rate increase to 0.5 deg/sec has been deleted. The landmark tracking rate of 0.3 deg/sec will be maintained. The maneuver will be terminated as before on the AGS calibration pitch gimbal angle. Page 47: The AGS calibration attitude has been changed to the following CSM gimbal angles. Pitch: 22.5° Yaw: 337.5° Roll: 7.5° Page 54: To provide LM high gain communications, the LM jettison will now be performed with the CSM pitched up 45° with respect to the local horizontal at 90° east longitude. This local attitude corresponds to the following gimbal angles and look angles. IGA: 25.3° θ_e: 52.7° MGA: 0.0° ϕ_e:176.1° OGA: 0.0° θ_s: 43.1° ϕ : 0.3°	7/15/69

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MSC INTERNAL NOTE 69-FM-203

July 11, 1969

SEPARATION PROCEDURES FOR APOLLO 11 NOMINAL, ALTERNATE, AND ABORT MISSIONS

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July 14, 1969

APOLLO 10 RTACF POSTMISSION REPORT

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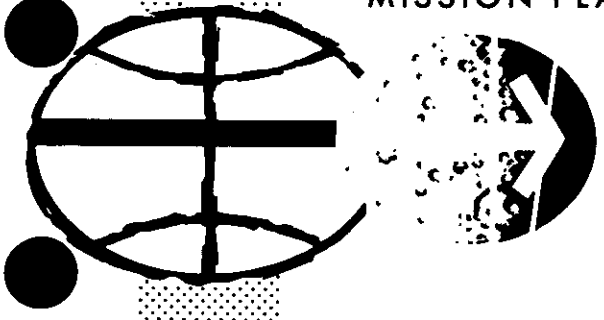

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July 14, 1969

VERIFICATION OF COMANCHE 55 ORBITAL NAVIGATION PROGRAM

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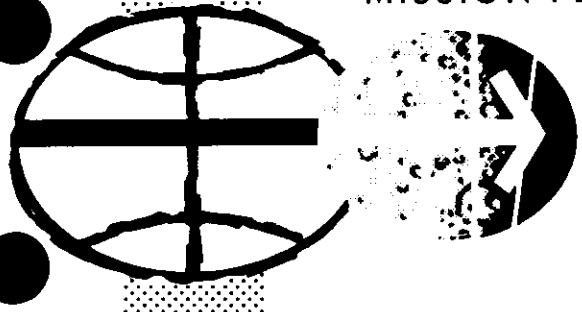
July 14, 1969

APOLLO 11 REAL-TIME AUXILIARY COMPUTING FACILITY WORK SCHEDULE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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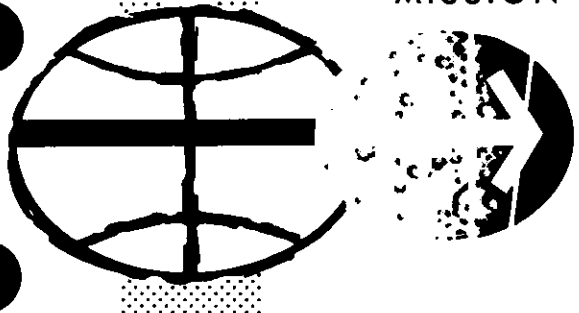
July 14, 1969

OPERATIONAL SUPPORT PLAN FOR THE RTACF APOLLO 11 TRAJECTORY SUPPORT CHIEFS PROCEDURES HANDBOOK

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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July 14, 1969

REVISION 1 TO THE APOLLO 11 (MISSION G) SPACECRAFT DISPERSION ANALYSIS VOLUME II TRANSLUNAR AND TRANSEARTH PHASES

Lunar Mission Analysis Branch
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July 14, 1969

APOLLO 11

LUNAR TRAJECTORY NOTES

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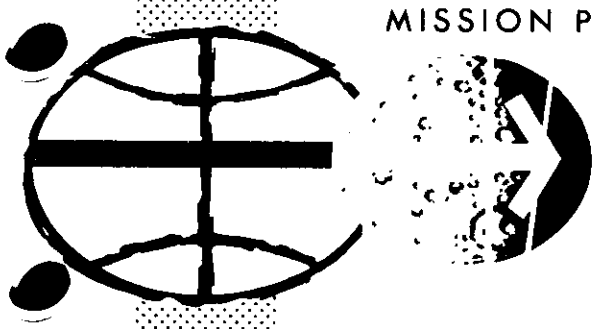

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MISSION: Apollo 11

DOCUMENT: MSC IN 69-FM-209

TITLE: Apollo 11 Lunar Trajectory Notes

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SHORT TITLE OF CHANGE: Corrections

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Insert replacement page as indicated on the attached list.

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DOCUMENT: MSC IN 69-FM-209

TITLE: Apollo 11 Lunar Trajectory Notes

AMENDMENT 2

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MSC INTERNAL NOTE NO. 69-FM-197

July 3, 1969

REVISION 1 TO VIEWS FROM THE CM AND LM DURING THE FLIGHT OF APOLLO 11 (MISSION G)

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July 22, 1969

SOLAR AND ATMOSPHERIC PERTURBATIONS TO THE ORBIT OF A SATELLITE OF EITHER MARS OR VENUS

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July 23, 1969

A SURVEY OF 30-DAY STAYTIME ORBITAL MISSIONS TO VENUS (1972-2000)

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MISSION PLANNING AND ANALYSIS DIVISION

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July 24, 1969

A SOLUTION TO THE CONSTRAINED ALTITUDE PLANETARY FLYBY PROBLEM USING THE WEIGHTED LEAST SQUARES ITERATION TECHNIQUE

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July 30, 1969

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August 1, 1969

LANDING DISPERSION FOR A CONSTANT 4g REENTRY

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August 4, 1969

RECOMMENDED LOI PROCEDURES FOR HYBRID LUNAR MISSIONS

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MISSION PLANNING AND ANALYSIS DIVISION

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August 8, 1969

PRELAUNCH GO/NO-GO COMPUTATIONS FOR THE APOLLO 11 MISSION

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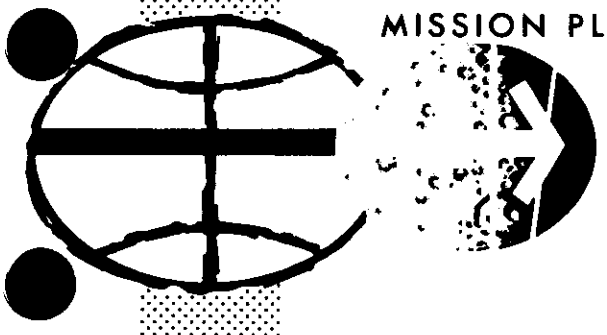

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MSC INTERNAL NOTE NO. 69-FM-222

August 11, 1969

PREDICTED LAUNCH ABORT LANDING POINT DATA COMPUTED FOR APOLLO 11

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SWITCHING LOGIC AND STEERING EQUATIONS FOR MULTIBURN EARTH ESCAPE MANEUVERS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-225

August 13, 1969

LOGIC AND EQUATIONS FOR THE REAL-TIME CALCULATIONS OF THE POWERED DESCENT ABORT CONSTANTS

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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Section

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Date of Paper: **October 27, 1969**

5. Author(s)
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AUGUST 19, 1969

MISSION CAPABILITIES OF MSC SHUTTLE

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MSC INTERNAL NOTE NO. 69-FM-227

September 23, 1969

GUIDANCE ANALYSIS OF ENTRY CORRIDORS FOR AERODYNAMIC BRAKING INTO ORBIT AROUND MARS OR VENUS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-228

AUGUST 26, 1969

ANALYTIC FORMULATION OF THREE WEDGE ANGLE CONSTRAINTS IN TRAJECTORY STUDIES

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-229

August 28, 1969

APOLLO APPLICATIONS PROGRAM TWO-AND-ONE-HALF-STAGES-TO-ORBIT TRACKING ANALYSIS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-230

August 28, 1969

CSM BATTERY CHARGER MODEL

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MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-231

August 29, 1969

AAP INVERTER MODEL

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MSC INTERNAL NOTE NO. 69-FM-232

September 2, 1969

DESCRIPTION OF APOLLO GUIDANCE ANALYSIS STATISTICAL TRIALS PROGRAM

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MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-233

September 2, 1969

PRELIMINARY APOLLO 12 (MISSION H-1)

TRAJECTORY DATA

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

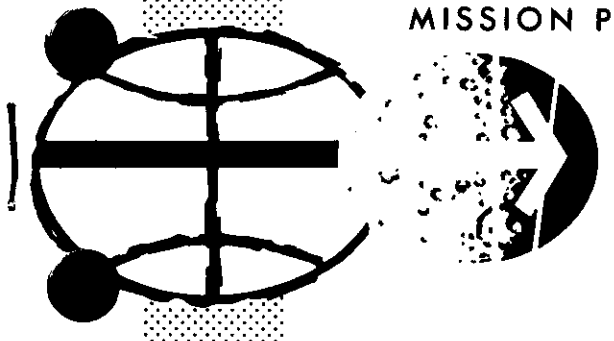
MSC INTERNAL NOTE NO. 69-FM-234

October 13, 1969

AN OPTIMAL, ANALYTIC SOLUTION TO THE LINEAR-GRAVITY, CONSTANT-THRUST TRAJECTORY PROBLEM

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-235

September 3, 1969

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September 10, 1969

APOLLO 9 ENTRY POSTFLIGHT ANALYSIS

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MSC INTERNAL NOTE NO. 69-FM-237

October 24, 1969

OPERATIONAL USE OF QUATERNIONS IN THE DESCRIPTION OF RIGID BODY MOTION

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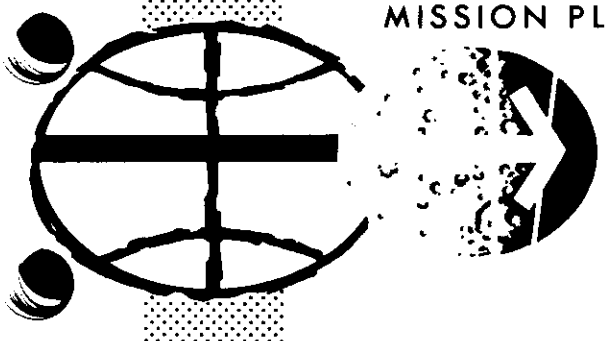
MISSION PLANNING AND ANALYSIS DIVISION



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October 24, 1969

OPERATIONAL USE OF QUATERNIONS IN THE DESCRIPTION OF RIGID BODY MOTION

Mathematical Physics Branch
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MSC INTERNAL NOTE NO. 69-FM-238

September 10, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1970

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MSC INTERNAL NOTE NO. 69-FM-239

October 23, 1969

RTCC REQUIREMENTS FOR MISSION H PROGRAM FOR COMPUTATION OF LM IMU TORQUING ANGLES WITH THE LM AND CSM IN THE DOCKED CONFIGURATION

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MSC INTERNAL NOTE NO. 69-FM-213

August 4, 1969

SUMMARY OF SATURN IB WORKSHOP TRAJECTORY ANALYSES

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-241

September 18, 1969

AAP LM-ATM DECOUPLED MISSION STUDY

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MSC INTERNAL NOTE NO. 69-FM-242

September 15, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 12 (MISSION H-1) VOLUME II OPERATIONAL MISSION PROFILE TRAJECTORY PARAMETERS, LAUNCHED NOVEMBER 14, 1969

Lunar Mission Analysis Branch,
Orbital Mission Analysis Branch, and
Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-243

October 21, 1969

APOLLO PORTABLE LIFE SUPPORT SYSTEM COMPUTER SIMULATION PROGRAM

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-244

September 19, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1971

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-245

SEPTEMBER 22, 1969

TASK MONITOR'S HANDBOOK

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MSC INTERNAL NOTE NO. 69-FM-246

September 22, 1969

PARAMETRIC ANALYSIS OF MSFN STATION COVERAGE FOR VARIOUS ORBITAL INCLINATIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-247

November 21, 1969

APOLLO 8 LANDMARK TRACKING GEOMETRY

Mathematical Physics Branch

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MSC INTERNAL NOTE NO. 69-FM-248

September 25, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 12 (MISSION H-1) VOLUME I HYBRID MISSION PROFILE LAUNCHED NOVEMBER 14, 1969

Lunar Mission Analysis Branch,
Landing Analysis Branch,
and
Orbital Mission Analysis Branch
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MSC INTERNAL NOTE NO. 69-FM-240

September 11, 1969

ABORT RESET POINTS FOR APOLLO 12

(MISSION H-1)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-250

September 25, 1969

RTCC REQUIREMENTS FOR APOLLO 12 (MISSION H-1) TRANSLUNAR INJECTION PROCESSOR

(This revision supersedes MSC Internal Note No. 69-FM-132 dated June 5, 1969)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-251

SEPTEMBER 26, 1969

Dist.

APOLLO 11 RTACF POSTMISSION REPORT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-252

APOLLO 8 ENTRY

POSTFLIGHT ANALYSIS

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[illegible]

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-253

September 24, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1970

(This internal note supersedes MSC IN 69-FM-238 dated September 10, 1969)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-254

September 30, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1972

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-255

October 23, 1969

RTCC REQUIREMENTS FOR THE LOI BURN GO/NO-GO PROCEDURE

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-256

OCTOBER 7, 1969

MINIMUM FLIGHT TIME AND FEASIBILITY OF MULTIPLE ORBIT TRANSFERS BETWEEN EARTH AND MARS AND BETWEEN EARTH AND VENUS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-257

October 14, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 12 (MISSION H-1)

VOLUME II

EARTH PHASE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-258

October 14, 1969

COMPARISON OF PARALLEL AND TANDEM STAGING OF NUCLEAR ORBITAL LAUNCH STAGES FOR INTERPLANETARY DEPARTURE

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-259

October 14, 1969

OPERATIONAL ABORT PLAN

VOLUME IV

RETURN TO EARTH SUMMARY

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-260

October 14, 1969

APOLLO 12 (MISSION H-1) SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-261

October 13, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 12 (MISSION H-1)

VOLUME I

LAUNCH PHASE

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE 69-FM-262

OCTOBER 14, 1969

SEPARATION PROCEDURES FOR APOLLO 12 NOMINAL, ALTERNATE, AND ABORT MISSIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-263

OCTOBER 17, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 12 (MISSION H-1) VOLUME III LUNAR PHASE

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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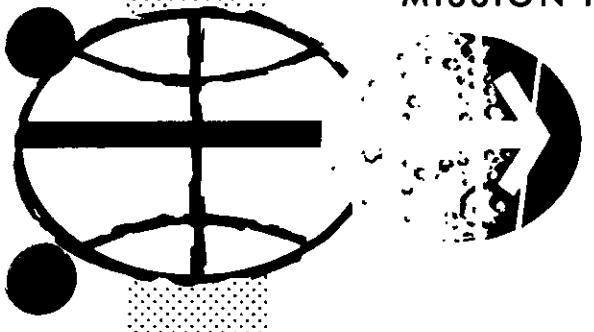
MSC INTERNAL NOTE NO. 69-FM-264

October 17, 1969

VIEWS FROM THE CM AND LM DURING THE FLIGHT OF APOLLO 12 (MISSION H-1)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-265

October 14, 1969

APOLLO 12 (MISSION H-1)

(AS-507/CSM 108/LM-6)

SPACECRAFT DISPERSION ANALYSIS

VOLUME I

NAVIGATION ERROR ANALYSIS

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

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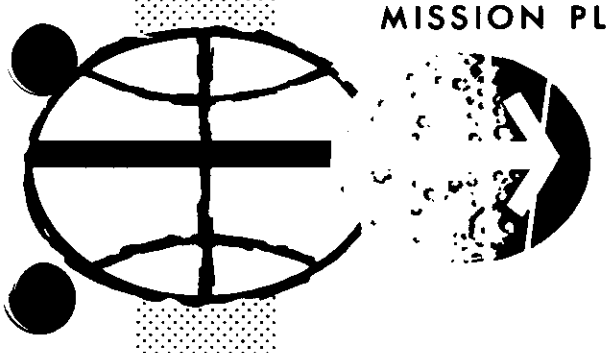
MSC INTERNAL NOTE NO. 69-FM-266

October 28, 1969

REVISION 1 TO THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 12 (MISSION H-1) VOLUME I HYBRID MISSION PROFILE LAUNCHED NOVEMBER 14, 1969

Lunar Mission Analysis Branch,
Landing Analysis Branch,
and Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

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DATE November 7, 1969

MISSION: H-1

DOCUMENT: MSC IN 69-FM-266

TITLE: Revision 1 to the Spacecraft Operational Trajectory for Apollo 12, Volume I - Hybrid Mission Profile Launched November 14, 1969

AMENDMENT 1

SHORT TITLE OF CHANGE: Corrections and additions

CHANGE DESCRIPTION: Insert replacement pages indicated on the attached list.

A black bar in the margin indicates area of change.

APPROVED BY: Ronald L. Berry
Ronald L. Berry, Chief
Lunar Mission Analysis Branch

Floyd V. Bennett
Floyd V. Bennett, Chief
Landing Analysis Branch

for H. Yoshimaki
Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer
John P. Mayer, Chief
Mission Planning and Analysis Division

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DATE: 11-30-71

MSC FORM 295 (JULY 1969) OT

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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

DATE November 13, 1969

MISSION: Apollo 12 (H-1)

DOCUMENT: MSC IN 69-FM-266

TITLE: REVISION 1 TO THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 12, VOLUME I - HYBRID MISSION PROFILE LAUNCHED NOVEMBER 14, 1969

AMENDMENT 2

SHORT TITLE OF CHANGE: Corrections.

CHANGE DESCRIPTION: Insert replacement pages indicated on the attached list. A black bar in the margin indicates the area of change.

APPROVED BY:

Ronald L. Berry, Chief
Lunar Mission Analysis Branch

Floyd V. Bennett, Chief for
Landing Analysis Branch

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

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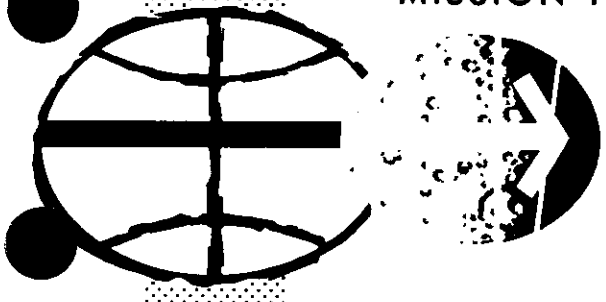
MSC INTERNAL NOTE NO. 69-FM-267

October 24, 1969

ENTRY MISSION PLAN - APOLLO 12 (MISSION H-1)

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-249

December 17, 1969

ACCURACY OF PARTIAL REVOLUTION LUNAR ORBIT TRAJECTORY SOLUTIONS

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-271

October 24, 1969

RECOMMENDED ENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR APOLLO 12 (MISSION H-1)

Landing Analysis Branch

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MSC INTERNAL NOTE NO. 69-FM-272

October 15, 1969

APOLLO 12 (MISSION H-1)
CREW CHARTS

Mission Planning Support Office
MISSION PLANNING AND ANALYSIS DIVISION

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UNITED STATES GOVERNMENT

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Mission Planning

TO : See list below

DATE: OCT 2 7 1969

File No. 69-FM13-536

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Amendment 1 to Apollo 12 (Mission H1) Crew Charts

Reference is made to MSC Internal Note No. 69-FM-272, "Apollo 12 (Mission H1) Crew Charts," by the Data Management Group, Mission Planning Support Office, dated October 15, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as Amendment 1 to the above referenced internal note. The amendments are as follows:

CSM Crew Chart 2	Nominal LOI 30-minute DPS abort--C. Foggatt, FAB/MPAD, page 5.
CSM Crew Chart 5-3	Star unit vector--C. Denham, MPB/MPAD, page 12.
CSM Crew Chart 8	Comparison between LM and CSM solutions for CSI maneuver as a function of abort time in powered descent--A. Dupont, OMAB/MPAD, page 15.
LM Crew Chart 1	Comparison between the LM and CSM solutions for CSI maneuver as a function of abort time in powered descent--A. Dupont, OMAB/MPAD, page 20.
LM Crew Chart 3	Powered descent maneuver chart--B. Taylor, LAB/MPAD, page 22.
LM Crew Chart 4	Ascent maneuver chart--D. Payne, LAB/MPAD, page 23.
LM Crew Chart 5-1	Planet half-unit vectors for a launch on November 14, 1600 hr. G.m.t.--J. Blucker, MPB/MPAD, page 24.
LM Crew Chart 5-1	Planet half-unit vectors for a launch on November 14, 1600 hr. G.m.t.--J. Blucker, MPB/MPAD, page 25.
LM Crew Chart 5-2	Planet half-unit vectors for a launch on November 16, 1900 G.m.t.--J. Blucker, MPB/MPAD, page 26.
LM Crew Chart 7	Perilune Altitude checks at PDI--B. Taylor, LAB/MPAD, page 32.
LM Crew Chart 9	LM RCS propellant profile--S. Mayfield, GPB/MPAD, page 34.

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TO : See list below

DATE: OCT 2 7 1969

File No. 69-FM13-538

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Amendment 2 to Apollo 12 (Mission H1) Crew Charts

Reference is made to MSC Internal Note 69-FM-272, "Apollo 12 (Mission H1) Crew Charts," by the Data Management Group, Mission Planning Support Office, dated October 15, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as Amendment 2 to the above referenced internal note. The amendments are as follows:

CSM Crew Chart 9	Total SM RCS propellant profile--A. Loyd, GPB/MPAD, page 16.
CSM Crew Chart 10	Oxygen remaining for mission for one tank versus time--W. Scott, GPB/MPAD, page 17.
CSM Crew Chart 11	Hydrogen remaining in one tank--W. Scott, GPB/MPAD, page 18.
CSM Crew Chart 12	Total spacecraft current--W. Scott, GPB/MPAD, page 19.
CSM Crew Chart 17	Gimbal angles for observing LM ascent stage through rendezvous windows following LM jettison--R. Prahl/ C. Fraley, FAB/MPAD, page 97.
LM Crew Chart 9	LM RCS Propellant Profile--S. Mayfield, GPB/MPAD, page 34.
LM Crew Chart 10	LM-6 total spacecraft current--M. Alexander, GPB/MPAD, page 35.
LM Crew Chart 11	LM-6 descent stage amp hours remaining--M. Alexander, GPB/MPAD, page 36.
LM Crew Chart 12	LM-6 ascent stage amp hours remaining--M. Alexander, GPB/MPAD, page 37.
LM Crew Chart 13	Descent oxygen tank quantities as a function of mission time--R. Swalin, GPB/MPAD, page 38.
LM Crew Chart 14	Descent water tank quantities as a function of mission time--R. Swalin, GPB/MPAD, page 39.

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UNITED STATES GOVERNMENT

Memorandum

TO : See list below

DATE: OCT 2 9 1969

File No. 69-FM13-544

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Amendment 3 to Apollo 12 (Mission H1) Crew Charts

Reference is made to MSC Internal Note 69-FM-272, "Apollo 12 (Mission H1) Crew Charts," by the Data Management Group, Mission Planning Support Office, dated October 15, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as amendment 3 to the above referenced internal note. The amendments are as follows:

CSM Crew Chart 2	Nominal LOI 30-minute DPS abort for a November 14 launch date--C. Foggatt,FAB/MPAD, page 5.
CSM Crew Chart 7	Pre-entry attitude timeline--J. Harpold, LAB/MPAD, page 14.
CSM Crew Chart 16-1	Rules for a do-it-yourself sighting schedule--C. Kauffman, MPB/MPAD, page 91.
CSM Crew Chart 18	Nominal LOI 30-minute DPS abort for a November 16 launch date--C. Foggatt, FAB/MPAD, page 98.
LM Crew Chart 10	LM-6 total spacecraft current--M. Alexander, GPB/MPAD, page 35.
LM Crew Chart 11	LM-6 descent stage amp hours remaining--M. Alexander, GPB/MPAD, page 36.
LM Crew Chart 12	LM-6 ascent stage amp hours remaining--M. Alexander, GPB/MPAD, page 37.

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DATE: 11-30-71

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

for RPP

Enclosures

Addressees: (See attached page)

FM13:MACollins:lg

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TO : See list below

DATE: OCT 3 1 1969

File No. 69-FM13-551

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Amendment 4 to Apollo 12 (Mission H1) Crew Charts

Reference is made to MSC Internal Note 69-FM-272, "Apollo 12 (Mission H1) Crew Charts," by the Data Management Group, Mission Planning Support Office, dated October 15, 1969.

The purpose of this memorandum is to provide the enclosed crew chart as amendment 4 to the above referenced internal note. The amendment is as follows:

LM Crew Chart 9	LM RCS propellant profile--S. Mayfield, GPB/MPAD, page 34.

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

for RPP

Enclosures

Addressees:
(See attached list)

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TO : See list below

DATE: NOV 3 1969

File No. 69-FM13-556

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Amendment 5 to Apollo 12 (Mission H1) Crew Charts

Reference is made to MSC Internal Note 69-FM-272, "Apollo 12 (Mission H1) Crew Charts," by the Data Management Group, Mission Planning Support Office, dated October 15, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as amendment 5 to the above referenced internal note. The amendments are as follows:

LM Crew Chart 3	Powered descent maneuver chart--B. Taylor, LAB/MPAD, page 22.
LM Crew Chart 4	Ascent maneuver chart--D Payne, LAB/MPAD, page 23.
LM Crew Chart 5-4	Planet half-unit vectors for a launch on November 16, 1900 hr. (lunar surface ref.)--J. Blucker, MPB/MPAD, page 29.

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

RPP

Addressees:
(See attached list)

Enclosures

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DATE: NOV 5 1969

File No. 69-FM13-562

TO : See list below

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Amendment 6 to Apollo 12 (Mission H1) Crew Charts

Reference is made to MSC Internal Note 69-FM-272, "Apollo 12 (Mission H1) Crew Charts," by the Data Management Group, Mission Planning Support Office, dated October 15, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as amendment 6 to the above referenced internal note. The amendments are as follows:

LM Crew Chart 4	Ascent maneuver chart for November 14 launch--D. Payne, LAB/MPAD, page 23.
LM Crew Chart 20	Manual abort from powered descent for November 14 launch--V. Hanssen, LAB/MPAD, page 99.
LM Crew Chart 21	Powered descent maneuver chart for November 16 launch--B. Taylor, LAB/MPAD, page 100.
LM Crew Chart 22	Ascent maneuver chart for November 16 launch--D. Payne, LAB/MPAD, page 101.

Michael A. Collins, Jr.

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

for RPP

Enclosures

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TO : See list below

DATE: NOV 6 1969

File No. 69-FM13-567

FROM : FM13/Mission Planning Support Office
Data Management Group

SUBJECT: Amendment 7 to the Apollo 12 (Mission H1) Crew Charts

Reference is made to MSC Internal Note 69-FM-272, "Apollo 12 (Mission H1) Crew Charts," by the Data Management Group, Mission Planning Support Office, dated October 15, 1969.

The purpose of this memorandum is to provide the enclosed crew charts as amendment 7 to the above referenced internal note. The amendments are as follows:

CSM Crew Chart 19	Loss of communications navigation procedures for abort from translunar coast at 8:00 hrs. GET for a November 16 launch--C. Kauffman, MPB/MPAD, pages 102-106.
CSM Crew Chart 20	Loss of communications navigation procedures for abort from lunar orbit for a November 16 launch--C. Kauffman, MPB/MPAD, pages 107-115.
CSM Crew Chart 21	Loss of communications navigation procedures during nominal transearth trajectory for a November 16 launch--C. Kauffman, MPB/MPAD, pages 116-120.
CSM Crew Chart 22	Rules for a do-it-yourself sighting schedule--C. Kauffman, MPB/MPAD, pages 121-126.
LM Crew Chart 23	Star half-unit vectors--J. Blucker, MPB/MPAD, page 127.

Michael A. Collins

Michael A. Collins, Jr.

APPROVED BY:

Carl R. Huss
for John P. Mayer
Chief, Mission Planning
and Analysis Division

RPP

Enclosures

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MSC INTERNAL NOTE NO. 69-FM-273

October 24, 1969

THE CONSUMABLES ANALYSIS FOR THE APOLLO 12 (MISSION H-1) SPACECRAFT OPERATIONAL TRAJECTORY

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

: See list below

DATE: NOV 4 1969

69-FM74-310

: FM/Chief, Mission Planning and Analysis Division

CT: Revision 1 to the consumables analysis supporting the operational trajectory

References

1. MSC Internal Note No. 69-FM-273, "Consumables Analysis for the Apollo 12 (Mission H-1) Spacecraft Operational Trajectory," dated Oct. 24, 1969.

2. FCSD document, "Final Apollo 12 Flight Plan (AS-507/CSM-108/LM-6)," dated Oct. 15, 1969.

Purpose

The purpose of this memorandum is to update the consumables analysis which supported the operational trajectory (reference 1).

Summary

The loaded consumables for Apollo 12 are adequate to support the nominal mission.

Discussion

The following table, notes, and figures reflect the current consumable margins for Apollo 12. The data in the table does not alter the margin found in reference 1 unless they are so indicated by a note. The notes following the table briefly provide the rationale supporting the changes. Finally, the figures following the notes pictorially describe the consumables usage as a function of ground elapsed time.

Pertinent assumptions concerning the individual analysis, other than those found in the various notes, may be obtained from reference 2. This document describes the biases, dispersions, and unusables associated with each subsystem in a considerable amount of detail. Any questions pertaining to the consumables information found in reference 2 or this memorandum should be directed to the Consumable Analysis Section (Martin L. Alexander, Apollo 12 Consumable Coordinator).

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MSC INTERNAL NOTE NO. 69-FM-275

October 31, 1969

APOLLO 12 (MISSION H-1) SPACECRAFT DISPERSION ANALYSIS VOLUME IV DESCENT AND ASCENT DISPERSION ANALYSES PART 1 - LUNAR DESCENT

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 69-FM-275 DATED OCTOBER 31, 1969

APOLLO 12 (MISSION H-1) SPACECRAFT DISPERSION ANALYSIS

VOLUME IV - DESCENT AND ASCENT DISPERSION ANALYSES, PART 1 - LUNAR DESCENT

By Gilbert L. Carman and Moises N. Montez

Change 1

November 7, 1969

Floyd V. Bennett, Chief
Landing Analysis Branch

John D. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacements, have been inserted, place this CHANGE SHEET between the cover and title page and write on the cover "CHANGE 1 inserted".

1. Replace pages 1, 10, 11, and 23.

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2. Identification: 69-FM-275

Page 1 of 1 Pages

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Branch: Landing Analysis
Section:

4. Title or Subject: APOLLO 12 (MISSION H-1) SPACECRAFT DISPERSION ANALYSIS, VOLUME IV - DESCENT AND ASCENT DISPERSION ANALYSES, PART 1 - LUNAR DESCENT ADDENDUM FOR

Date of Paper: November 7, 1969

5. Author(s): Gilbert L. Carman and M. N. Montez

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MSC INTERNAL NOTE NO. 69-FM-276

October 31, 1969

ADVANCED LUNAR EXPLORATION MISSION PLAN UTILIZING A POLAR ORBITING LUNAR SPACE STATION

Advanced Mission Design Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-279

October 27, 1969

APOLLO 12 (MISSION H-1) SPACECRAFT DISPERSION ANALYSIS VOLUME II TRANSLUNAR AND TRANSEARTH PHASES

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-280

November 4, 1969

APOLLO 12 (MISSION H-1) DISPERSION ANALYSIS

VOLUME IV

DESCENT AND ASCENT DISPERSION ANALYSES

PART 2

LUNAR ASCENT

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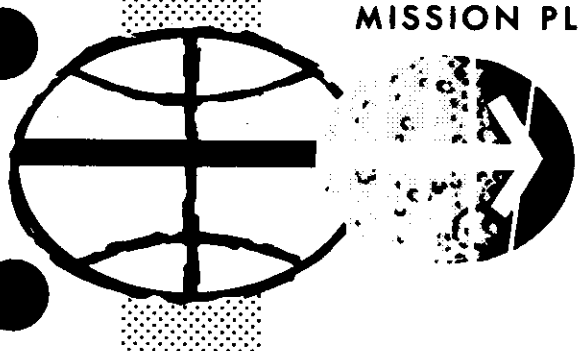

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MSC INTERNAL NOTE NO. 69-FM-282

November 4, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1973

Lunar Mission Analysis Branch
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MSC INTERNAL NOTE NO. 69-FM-283

November 7, 1969

APOLLO 10 ENTRY

POSTFLIGHT ANALYSIS

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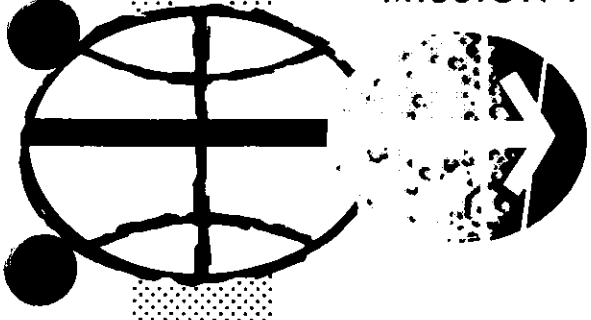
MSC INTERNAL NOTE NO. 69-FM-284

November 6, 1969

LAUNCH WINDOW EFFECTS ON THE APOLLO 12 (MISSION H-1) OPERATIONAL ABORT PLAN

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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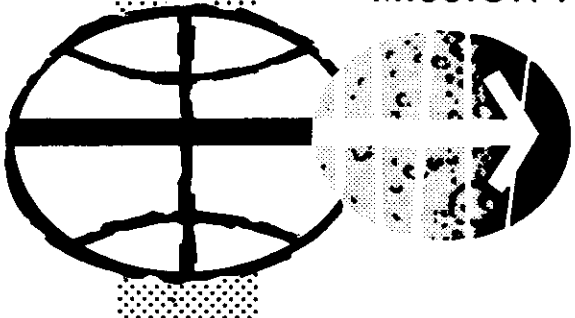
MSC INTERNAL NOTE NO. 69-FM-285

November 17, 1969

PANACEA: PROGRAM FOR ANALYZING NETWORKS AND THE ASSOCIATED CONSUMABLES FOR EXPERIMENTS AND ACTIVITIES

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-286

November 24, 1969

REVISION 4 RTCC REQUIREMENTS FOR APOLLO 13 (MISSION H-2): EARTH ORBIT INSERTION PROCESSOR

(This revision supersedes MSC Internal Note No. 69-FM-132 dated May 9, 1969)

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MSC INTERNAL NOTE NO. 69-FM-287

November 18, 1969

RTCC REQUIREMENTS FOR MISSION H-2: NON-FREE-RETURN MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

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MSC INTERNAL NOTE NO. 69-FM-288

November 12, 1969

CISLUNAR NAVIGATION SIGHTING DATA FOR ALTERNATE AND CONTINGENCY CHECKLIST FOR APOLLO 12 (MISSION H-1)

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-289

November 13, 1969

RTCC REQUIREMENTS FOR APOLLO 13 (MISSION H-2): XYZT AND FREE-RETURN MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

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MSC INTERNAL NOTE NO. 69-FM-290

November 21, 1969

SHORT ARC FITS OF DIFFERENT LENGTHS FOR AN APOLLO-TYPE ORBIT

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MISSION PLANNING AND ANALYSIS DIVISION

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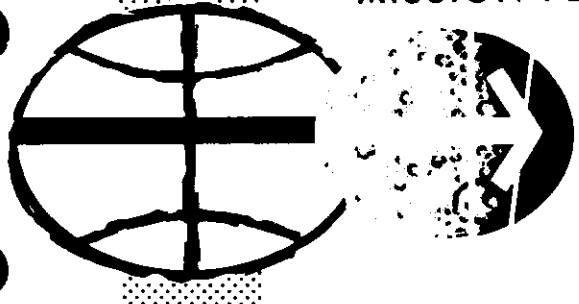
MSC INTERNAL NOTE NO. 69-FM-291

November 17, 1969

INORBIT ΔV STUDY FOR AN ADVANCED LOGISTICS SYSTEM (ALS) RESUPPLY MISSION

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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CHANGE HISTORY FOR 69-FM-291

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1	1/30/70	Replace pages 30 and 31: data keys were omitted from figures 14(a) and 14(b).

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MSC INTERNAL NOTE NO. 69-FM-292

November 6, 1969

APOLLO 12 (MISSION H-1) SPACECRAFT DISPERSION ANALYSIS VOLUME VII DISPERSION SUMMARY

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS BRANCH

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MSC INTERNAL NOTE NO. 69-FM-293

November 12, 1969

CISLUNAR STAR AVAILABILITY DATA FOR APOLLO 12 (MISSION H-1): NOVEMBER 14, 1969 LAUNCH

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MSC INTERNAL NOTE NO. 69-FM-294

November 28, 1969

BASIC CHARACTERISTICS OF PARKING ORBITS ABOUT MARS FOR USE IN PRELIMINARY MISSION PLANNING

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-295

November 7, 1969

REVISION 1 TO SEPARATION PROCEDURES FOR APOLLO 12 (MISSION H-1) NOMINAL, ALTERNATE, AND ABORT MISSIONS

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-296

November 7, 1969

OPERATIONAL LM ABORT AND CSM RESCUE PLAN FOR APOLLO 12 (MISSION H-1) VOLUME I ABORTS FROM POWERED DESCENT AND ASCENT

Landing Analysis Branch
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MSC INTERNAL NOTE NO. 69-FM-269

October 17, 1969

OPERATIONAL LUNAR ORBIT ATTITUDE SEQUENCE FOR APOLLO 12 (MISSION H-1)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-298

NOVEMBER 19, 1969

ENTRY MONITORING SYSTEM RANGING WITH CROSS-RANGE CONTROL

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-299

November 10, 1969

ONBOARD NAVIGATION ACCURACIES FOR THE APOLLO 12 (MISSION H-1) RENDEZVOUS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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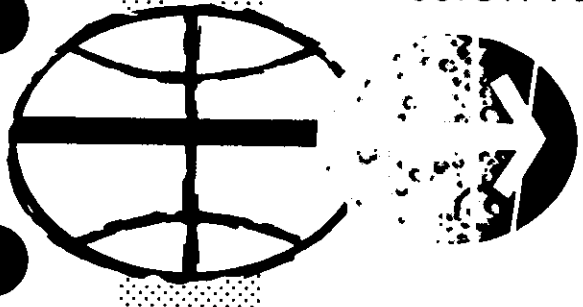
MSC INTERNAL NOTE NO. 69-FM-300

November 21, 1969

ABORT REQUIREMENTS FOR LUNAR LANDING MISSIONS WHICH UTILIZE THREE - IMPULSE LOI AND TEI MANEUVERS

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-301

November 21,1969

A PARAMETRIC STUDY OF LITHIUM HYDROXIDE REQUIREMENTS FOR CARBON DIOXIDE REMOVAL USING APOLLO LUNAR MODULE FLIGHT DATA

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-302

November 10, 1969

FINAL CONSUMABLES SUMMARY FOR THE APOLLO 12 MISSION

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-303

November 13, 1969

OPERATIONAL LM ABORT AND CSM RESCUE PLAN FOR APOLLO 12
VOLUME II
RENDEZVOUS AND RESCUE

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-304

November 10, 1969

FINAL OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR APOLLO 12 (MISSION H-1)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-305

November 12, 1969

APOLLO 12
LUNAR TRAJECTORY NOTES

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-306

November 18, 1969

CISLUNAR NAVIGATION SIGHTING DATA FOR ALTERNATE AND CONTINGENCY CHECKLIST FOR APOLLO 12: NOVEMBER 16, 1969 LAUNCH

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-307

December 1, 1969

AN ACTIVITIES SCHEDULER ENVIRONMENTAL CONTROL SYSTEM MODEL

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-308

November 26, 1969

DESCRIPTION OF THE REVISED DKI LOGIC TO BE USED FOR APOLLO MISSION H-3 AND SUBSEQUENT MISSIONS

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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IN REPLY REFER TO: 70-FM61-39

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MEMORANDUM TO: See list below

FROM : FM6/Chief, Orbital Mission Analysis Branch

SUBJECT : Transmittal of detailed programming requirements - H-3 requirement

The enclosure constitutes change 1 to MSC Internal Note no. 69-FM-308 which presents detailed requirements for the real-time computer program to be employed in support of the Apollo mission H-3 and subsequent missions. This change will provide the capability of doing DKI maneuvers at fractional period intervals instead of being limited to scheduling maneuvers on a fixed maneuver line.

Edgar C. Lineberry

Edgar C. Lineberry

APPROVED BY:

for John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:
See attached list

ECL:fc

ORIGINAL DESTROYED

DATE: 11-30-71

NARA SW Box E157G-43

Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: 70-FM61-89

JUL 17 1970

MEMORANDUM TO: See list below

FROM : FM6/Chief, Orbital Mission Analysis Branch

SUBJECT : Transmittal of detailed programming requirements

The enclosure constitutes change 2 to MSC Internal Note No. 69-FM-308 which presents detailed requirements for the real-time computer program to be employed in support of the Apollo mission H-3 and subsequent missions. This change will allow a "phasing only" maneuver to be performed on the opposite end of the maneuver line from the NSR maneuver point.

Edgar C. Lineberry

Edgar C. Lineberry

APPROVED BY:

William A. Sullivan

for John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:
See attached list

ECL:fc

ORIGINAL DESTROYED

DATE: 11-30-71

NARA SW Box E157G-43

Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF: 70-FM92-30

December 22, 1970

MEMORANDUM TO: See list below

FROM : FM9/Program Development Branch

SUBJECT : Transmittal of detailed programming requirements for Skylab RTCC real time program

The enclosure constitutes Change 3 to MSC Internal Note No. 69-FM-308 which presents detailed requirements for the real-time computer program to be employed in support of the Apollo mission H-4 and subsequent missions. This change will allow the DKI to iterate on four maneuvers; and therefore, it will be able to solve the Skylab rendezvous sequence in one run. The program is also changed to converge on height and phase at TPI instead of at NSR. This will simplify the DKI logic and make it more straightforward.

Robert R. Regelbrugge

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr.
Chief, Flight Software Branch

Enclosure

Addressees: (See attached list)

FM9:JWKahanek:rmr

NARA SW Box E157G-43

Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF: FM92 (71-47)

APR 16 1971

MEMORANDUM

TO: See list below

FROM: FM9/Program Development Branch

SUBJECT: Transmittal of Detailed Programming Requirements for Skylab RTCC Real Time Program

The enclosure constitutes Change 4 to MSC Internal Note No. 69-FM-308 which presents detailed requirements for the real-time computer program to be employed in support of Skylab missions. This change will allow the following:

1. Input delta time between NCC and NSR.

2. Ability to compute the relative out-of-plane at NSR and apply this out-of-plane on an NSR alone sequence.

3. Ability to change the time of NSR on the NSR alone route to maintain TPI time. This is identical to the CDH iterate route in the Apollo program.

This change also defines the additional input required.

Robert R. Regelbrugge

ORIGINAL DESTROYED

APPROVED BY:

DATE: 11-30-71

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Data Processing Branch concurs with the above recommendations.

James C. Stokes, Jr.
Acting Chief, Data Processing Branch

Enclosure

Addressees: (See attached list)

FM9/JWKahanek:rmr:4/5/71:4751

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-309

December 1, 1969

THE PROPULSION CONSUMABLES MODEL FOR AN EVENT SCHEDULING PROGRAM

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-310

December 4, 1969

CISLUNAR STAR AVAILABILITY DATA FOR APOLLO 12 (MISSION H-1): NOVEMBER 16, 1969 LAUNCH

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-311

December 2, 1969

VELOCITY REQUIREMENTS FOR MARS STOPOVER/VENUS SWINGBY MISSIONS IN 1981

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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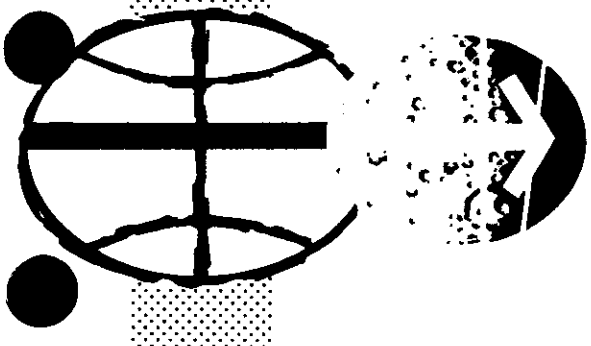
MSC INTERNAL NOTE NO. 69-FM-312

December 1, 1969

EARTH LAUNCH WINDOW ANALYSIS OF 1981 MARS STOPOVER/VENUS SWINGBY MISSIONS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 69-FM-313

December 2, 1969

PRELAUNCH GO/NO-GO COMPUTATIONS FOR THE APOLLO 12 MISSION

Flight Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-314

December 3, 1969

PREDICTED LAUNCH ABORT LANDING POINT DATA COMPUTED FOR APOLLO 12

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-315

December 5, 1969

ABORT REQUIREMENTS FOR CSM-ONLY POLAR LUNAR MISSIONS UTILIZING THREE-IMPULSE LOI AND TEI MANEUVERS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-01254

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-316

December 24, 1969

PRELIMINARY CONSUMABLES ANALYSIS FOR THE APOLLO J-TYPE MISSIONS

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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MSC-01262

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-317

January 8, 1970

APPLICATION OF BROUWER'S ARTIFICIAL SATELLITE THEORY TO COMPUTATION OF THE STATE TRANSITION MATRIX

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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MSC-01264

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

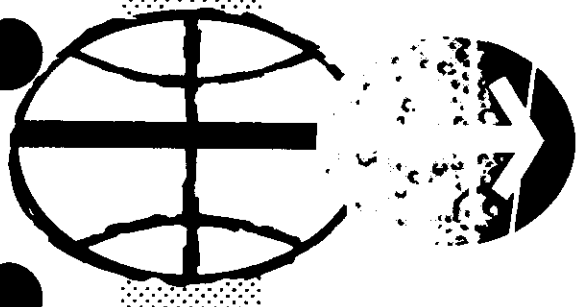
MSC INTERNAL NOTE NO. 69-FM-318

December 24, 1969

EARTH LAUNCH WINDOW ANALYSIS OF THE 1986 MARS CONJUNCTION CLASS MISSION

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01265

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-319

December 26, 1969

APOLLO 12 NAVIGATION PROCEDURES

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-297

November 6, 1969

OUT-THE-WINDOW VISIBILITY DURING LUNAR DESCENT OF APOLLO 12 (MISSION H-1)

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC-01276

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-322

January 23, 1970

THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 13 (MISSION H-2)

VOLUME I
HYBRID MISSION PROFILE FOR A MARCH 12, 1970 LAUNCH

Lunar Mission Analysis Branch,
Landing Analysis Branch,
and
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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HOUSTON, TEXAS

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MSC-01278

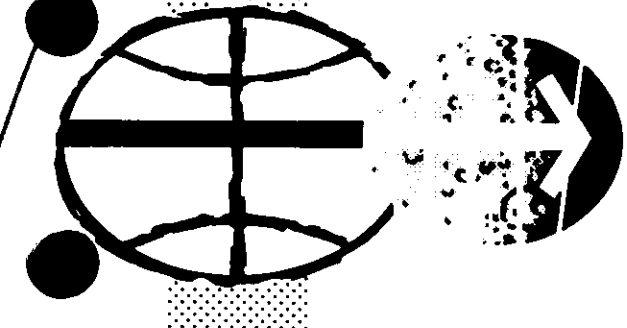
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-323

February 6, 1970

OPTIMUM INSTANTANEOUS IMPULSIVE ORBITAL INJECTION TO ATTAIN A SPECIFIED ASYMPTOTIC VELOCITY VECTOR

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01279

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-324

December 31, 1969

APOLLO 12 RTACF POSTMISSION REPORT

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

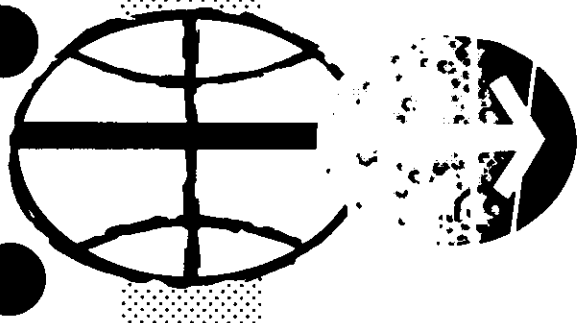
MSC INTERNAL NOTE NO. 69-FM-325

February 6, 1970

NONCOPLANAR MINIMUM ΔV TWO-IMPULSE AND THREE-IMPULSE ORBITAL TRANSFER FROM A REGRESSING OBLATE EARTH ASSEMBLY PARKING ELLIPSE ONTO A FLYBY TRANS-MARS ASYMPTOTIC VELOCITY VECTOR

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01273

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-321

December 23, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 13 (MISSION H-2), LAUNCHED MARCH 12, 1970 VOLUME II - TRAJECTORY PARAMETERS

Lunar Mission Analysis Branch
Orbital Mission Analysis Branch
and
Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E157G-44

Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: 70-FM47-243

MEMORANDUM TO: See list below

FROM : FM4/Assistant Chief, Mathematical Physics Branch

SUBJECT : Modifications to the RTCC offline star-horizon observation processor for Apollo 14

1. Reference: MSC Internal Note 69-FM-326, "RTCC Offline Requirements for H-2: Star-Horizon Observation Processor," by Paul Flanagan, MPB, and Robert Kidd, TRW Systems Group, February 24, 1970.

2. The modifications to the RTCC offline star-horizon observation processor for Apollo 14 are of two types. The first is the inclusion of additional quantities which will aid in the analysis of the sightings. In addition to calculating new quantities, a statistical summary of several parameters for each star is required. The second modification is to change the computer format so that the desired information is more readily available.

Emil R. Schiesser

The Flight Software Branch concurs with the above recommendation and requests IBM to proceed accordingly.

James C. Stokes, Jr., Chief
Flight Software Branch

APPROVED BY:

for John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure
Addressees: (See attached list)
FM4:RTSavely:rmr

NARA SW Box E157G-45

Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

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REPLY TO ATTN OF: 70-FM47-280

November 30, 1970

MEMORANDUM TO: See List Below

FROM : FM/Mission Planning and Analysis Division

SUBJECT : Change for RTCC offline formulation for Apollo 14: Star-Horizon Observation Processor

1. Reference: MSC Internal Note No. 69-FM-326, "RTCC Offline Requirements for H-2: Star-Horizon Observation Processor," FM4/ P. Flanagan and TRW/R. Kidd, February 24, 1970.

2. The reference internal note should be updated as defined in the attached change sheet, and the RTCC offline star horizon observation processor should be altered accordingly for Apollo 14. The equation for D_3 is currently incorrectly defined.

Emil R. Schiesser
Assistant Chief
Mathematical Physics Branch

The Flight Software Branch concurs with the above recommendation and requests IBM to proceed accordingly.

James C. Stokes, Jr., Chief
Flight Software Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Attachment

Distribution: (See attached list)

FM4:JBlucker:fdb

NARA SW Box E157G-45

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

JAN 27 1971

REPLY TO
ATTN OF: 71-FM47-13

MEMORANDUM TO: See List Below

FROM : FM/Mission Planning and Analysis Division

SUBJECT : Change for RTCC offline formulation for Apollo 14: Star-Horizon Observation Processor

1. Reference: MSC Internal Note No. 69-FM-326, "RTCC Offline Requirements for H-2: Star-Horizon Observation Processor," FM4/ P. Flanagan and TRW/R. Kidd, February 24, 1970.

2. The reference internal note should be updated as defined in the attached change sheet, and the RTCC offline star horizon observation processor should be altered accordingly for Apollo 14. The equation for the terminator visibility check is currently incorrectly defined.

Emil R. Schiesser
Assistant Chief
Mathematical Physics Branch

The Flight Software Branch concurs with the above recommendation and requests IBM to proceed accordingly.

James C. Stokes, Jr., Chief
Flight Software Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Attachment

Distribution: (See attached list)

FM4:JBlucker:fdb

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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REPLY TO ATTN OF: FM4 (71-67)

MAY 18 1971

MEMORANDUM

TO: See List Below

FROM: FM/Mission Planning and Analysis Division

SUBJECT: Change for RTCC Offline Formulation for Apollo 15: Star-Horizon Observation Processor

1. Reference: MSC Internal Note No. 69-FM-326, "RTCC Offline Requirements for H-2: Star-Horizon Observation Processor," FM4/ P. Flanagan and TRW/R. Kidd, February 24, 1970.

2. The reference internal note should be updated as defined in the attached change sheet, and the RTCC offline star horizon observation processor should be altered accordingly for Apollo 15. The equation for SFOV is currently incorrectly defined.

Emil R. Schiesser
Assistant Chief
Mathematical Physics Branch

The Data Processing Branch concurs with the above recommendation and requests IBM to proceed accordingly.

James J. Stokes, Jr., Acting Chief
Data Processing Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Attachment

cc: (See attached list)

FM4/REEckelkamp:fdb:5/5/71

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MSC-01286

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

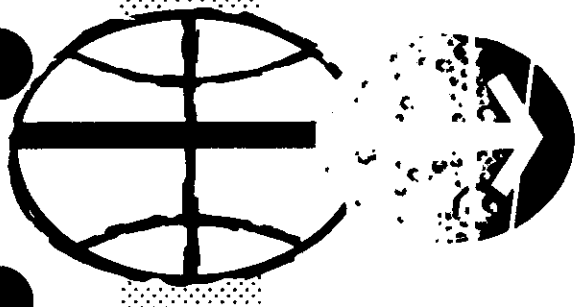
MSC INTERNAL NOTE NO. 69-FM-327

December 31, 1969

RTCC REQUIREMENTS FOR MISSION H-3: LOI TARGETING

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

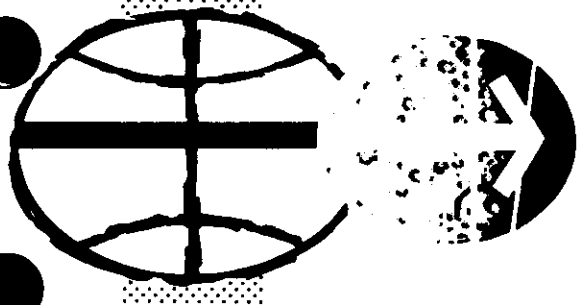
MSC INTERNAL NOTE NO. 69-FM-328

December 31, 1969

APOLLO 14 (MISSION H-3) BASELINE MISSION PROFILE

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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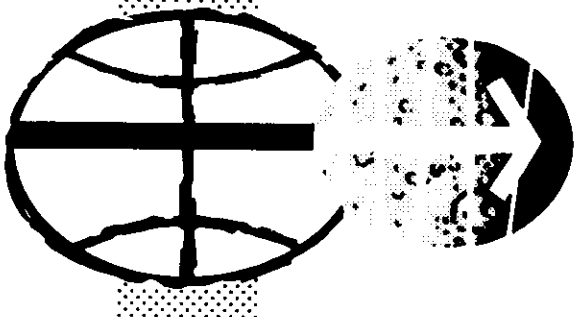
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-329

January 16, 1970

THE SEARCH FOR SURVEYOR III

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

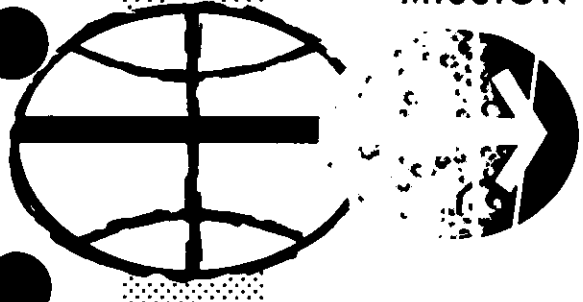
MSC INTERNAL NOTE NO. 70-FM-1

January 22, 1970

THE EFFECT OF ABORT CONSIDERATIONS ON MSC SHUTTLE CRAFT INJECTION CONDITIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01503

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

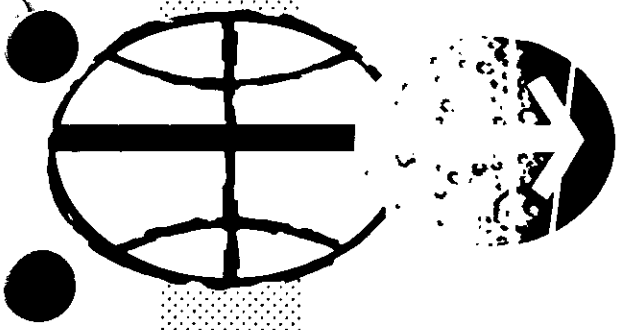
MSC INTERNAL NOTE NO. 70-FM-2

February 6, 1970

RTCC REQUIREMENTS FOR MISSION H-3 AND SUBSEQUENT MISSIONS: ENTRY PHASE

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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IN REPLY REFER TO: 70-FM23-96

APR 27 1970

MEMORANDUM TO: See List Below

FROM : FM2/Chief, Landing Analysis Branch

SUBJECT : Change Sheet for the RTCC Requirements for Mission H-3 and Subsequent Missions: Entry Phase

Reference: MSC Internal Note 70-FM-2 by J. W. Tolin, J. K. Burton, and D. W. Heath, "RTCC Requirements for Mission H-3 and Subsequent Missions: Entry Phase," dated February 6, 1970.

The enclosed changes should be incorporated in the referenced document.

Floyd V. Bennett

APPROVED BY:

for John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr.
Chief, Flight Software Branch

Enclosure

Addressees:
(See attached page)

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-2 DATED February 6, 1970

RTCC REQUIREMENTS FOR MISSION

H-3 AND SUBSEQUENT MISSIONS: ENTRY PHASE

By James W. Tolin, Jr, John K. Burton,
and David W. Heath

Change 2

December 30, 1970

Floyd V. Bennett, Chief
Landing Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacement pages, have been inserted, place this CHANGE SHEET between the cover and title page and write on the cover, "CHANGE 2 inserted."

Replace pages 12, 13, 24, and 29.

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MSC-01504

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-3

January 22, 1970

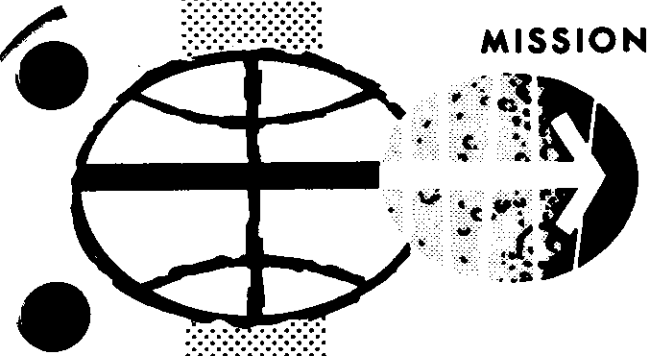
LOGISTICS VEHICLE ORBITAL TRAJECTORY CONSIDERATIONS AND TYPICAL MISSION PROFILES AND ATTITUDE TIMELINES

VOLUME I

RENDEZVOUS AND MANEUVER CONSIDERATIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-4

January 28, 1970

VIEWS FROM THE CM AND LM DURING THE FLIGHT OF APOLLO 13 (MISSION H-2)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-5

January 22, 1970

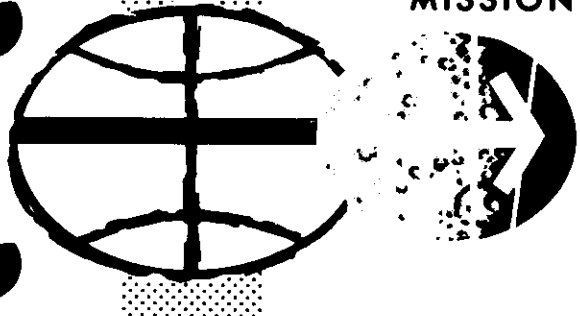
LOGISTICS VEHICLE ORBITAL TRAJECTORY CONSIDERATIONS AND TYPICAL MISSION PROFILES AND ATTITUDE TIMELINES

VOLUME II

TYPICAL MISSION PROFILES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01511

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-6

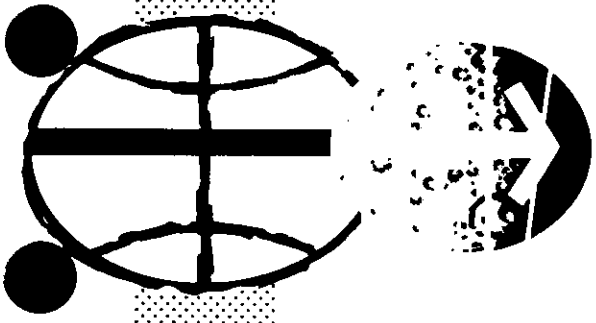
January 30, 1970

APOLLO 13 (MISSION H-2)

MSFN NAVIGATION

ERROR ANALYSIS

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01513

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

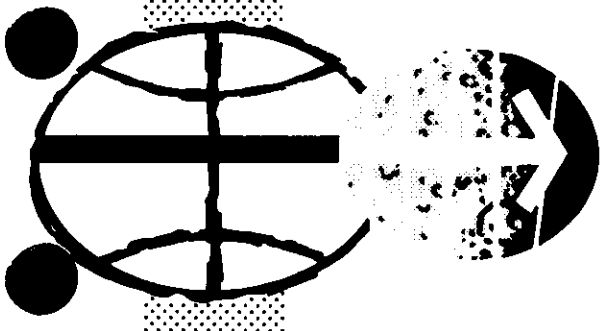
MSC INTERNAL NOTE NO. 70-FM-7

January 30, 1970

THE CONSUMABLES ANALYSIS FOR THE APOLLO 13 (MISSION H-2) SPACECRAFT OPERATIONAL TRAJECTORY; MARCH 12, 1970 LAUNCH DATE

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01515

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

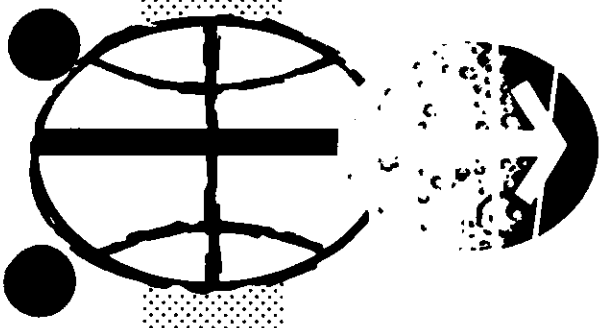
MSC INTERNAL NOTE NO. 70-FM-8

January 29, 1970

A PRELIMINARY PARAMETRIC TRANSLATIONAL STUDY FOR THE AAP COMMAND/SERVICE MODULE

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-9

JANUARY 30, 1970

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 13 (MISSION H-2) VOLUME II - RENDEZVOUS AND RESCUE

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-10

JANUARY 30, 1970

EVALUATION OF THE EXPERIMENTS AND OPERATIONS SCHEDULING PROCEDURE (ESP) PROGRAM

ORBITAL MISSION ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

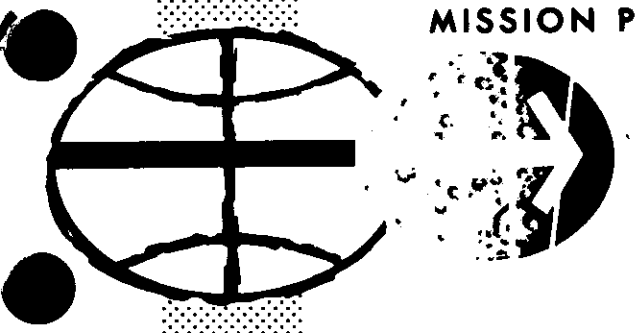
MSC INTERNAL NOTE NO. 70-FM-11

February 6, 1970

RTCC REQUIREMENTS FOR APOLLO 14: LUNAR FLYBY MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

(This revision supersedes MSC Internal Note No. 69-FM-199)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS 77058

IN REPLY REFER TO: 70-FM54-113

MAY 25 1970

MEMORANDUM TO: See attached list

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT : Corrections to the flyby options of the RTCC Midcourse Correction Processor as specified in Internal Note No. 70-FM-11

The three flyby options use similar logic for the first five steps of each option. Option 8, the SPS lunar flyby, will be used as an example; but the changes indicated apply to each option. These changes have been coordinated with Flight Software Branch and IBM.

Ronald L. Berry

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendation.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

Addressees:
(See attached list)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-12

February 13, 1970

APOLLO 13 (MISSION H-2) SPACECRAFT DISPERSION ANALYSIS VOLUME IV DESCENT AND ASCENT DISPERSION ANALYSES

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-13

January 22, 1970

LOW ALTITUDE LANDMARK TRACKING ATTITUDE STUDIES

LUNAR MISSION ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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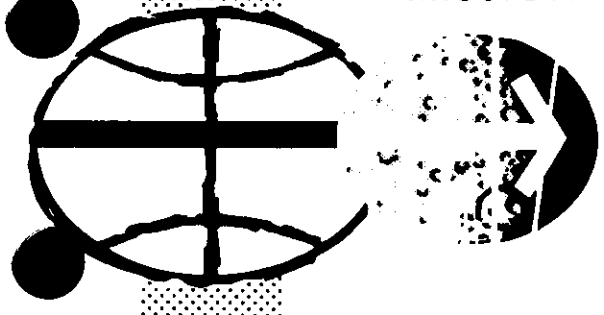
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-14

February 16, 1970

RTCC REQUIREMENTS FOR APOLLO 14: NON-FREE-RETURN MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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IN REPLY REFER TO: 70-FM54-112

MAY 25 1970

MEMORANDUM TO: See attached list

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT : RTCC requirements for Apollo 14 (H-3): Non-free return modes of the translunar midcourse correction processor - Change 1

Enclosed is Change 1 to MSC Internal Note No. 70-FM-14. This change includes the addition of the capability to compute the "DPS-monitor ΔV" for both non-free return options (options 4 and 5) of the translunar midcourse correction processor. Also included are some minor cleanup items relevant to the original documentation.

Ronald L. Berry

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

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MSC-01552

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

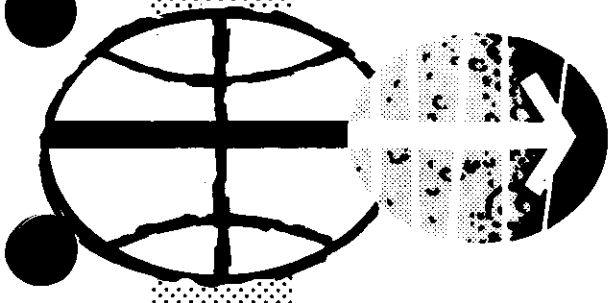
MSC INTERNAL NOTE NO. 70-FM-15

February 16, 1970

RTCC REQUIREMENTS FOR APOLLO 14: XYZT AND FREE-RETURN MODES OF THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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Mission Planning and Analysis Division
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IN REPLY REFER TO: 70-FM54-124

MAY 25 1970

MEMORANDUM TO: See attached list

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT : RTCC requirements for Apollo 14 (H-3): XYZT and free-return modes of the translunar midcourse correction processor - Change 1

Enclosed is Change 1 to MSC Internal Note No. 70-FM-15. This change reflects some cleanup to the original documentation plus the addition of the capability to compute the "DPS-monitor ΔV" for option 1 (XYZT mode).

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-16

February 13, 1970

USERS MANUAL FOR GSVPP (GENERALIZED STATE VECTOR PROCESSING PROGRAM)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

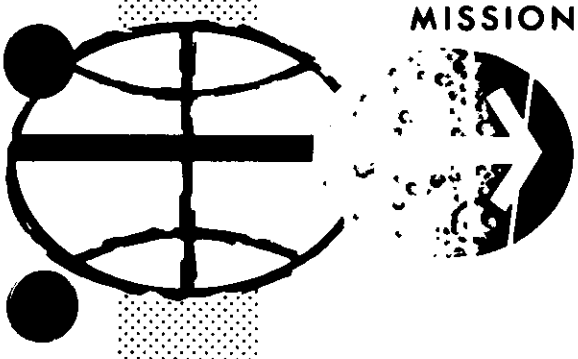
MSC INTERNAL NOTE NO. 70-FM-17

February 4, 1970

APOLLO 13 PRELIMINARY ATTITUDE SEQUENCE — LOI TO UNDOCKING

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

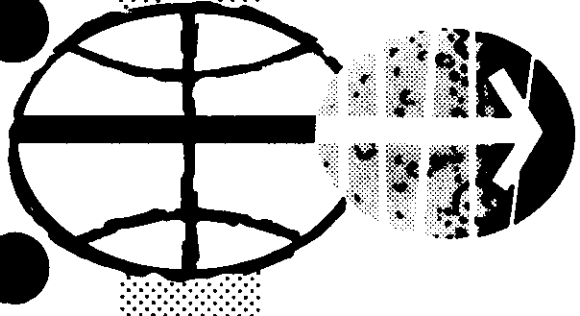
MSC INTERNAL NOTE NO. 70-FM-18

February 10, 1970

ΔV REQUIREMENTS FOR RETRIEVAL OF NUCLEAR ORBITAL LAUNCH VEHICLES AFTER INTERPLANETARY DEPARTURE

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-19

JANUARY 30, 1970

RTCC REQUIREMENTS FOR APOLLO 14 (H-3) MISSION: MOON-CENTERED RETURN-TO-EARTH CONIC SUBPROCESSOR

MISSION PLANNING AND ANALYSIS DIVISION
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CHANGE SHEET

FOR

MSC INTERNAL NOTE NO. 70-FM-19, DATED JANUARY 30, 1970

RTCC REQUIREMENTS FOR APOLLO 14 (H-3) MISSION:

MOON-CENTERED RETURN-TO-EARTH CONIC SUBPROCESSOR

By Frances M. Northcutt
TRW Systems Group

October 1, 1971

Ronald L. Berry, Chief
Planetary Mission Analysis Branch

for John P. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black or dashed line indicates the area of change. (See Change History)

After the attached pages, which are replacements, have been inserted, insert this change sheet between the cover and the title page and write on the cover "CHANGE 1 inserted".

1. Replace pp. A-69 and A-70, A-75 through A-84.

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MSC-01281

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-326

February 24, 1970

RTCC OFFLINE REQUIREMENTS FOR H-2: STAR-HORIZON OBSERVATION PROCESSOR

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-01564

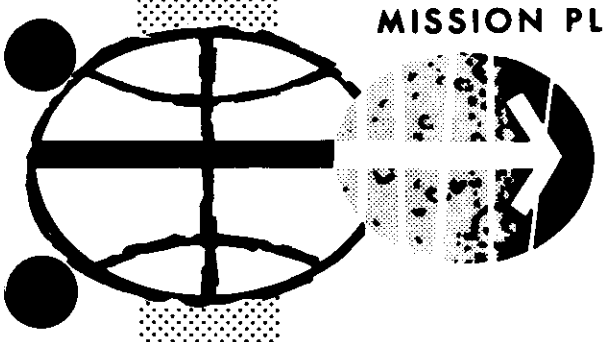
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-21

February 13, 1970

APOLLO POSTFLIGHT TRAJECTORY PARAMETERS

Mission Planning Support Office
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01566

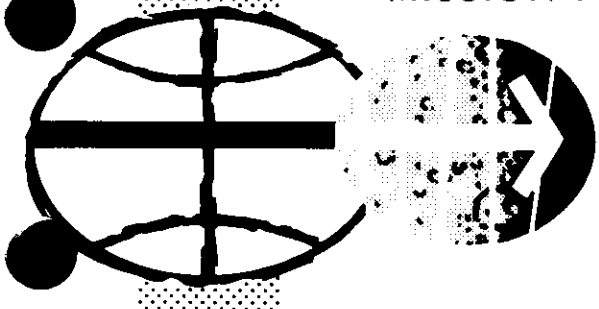
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-22

Feburary 25, 1970

OPTIMUM TWO-DIMENSIONAL SINGLE-STAGE LAUNCH FROM THE SURFACE OF MARS

Advanced Mission Design Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01567

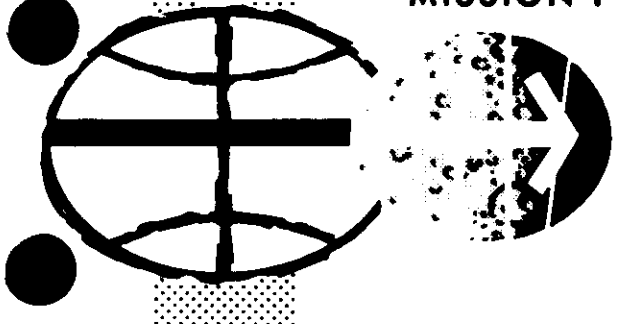
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-23

March 23, 1970

RTCC REQUIREMENTS FOR APOLLO 14 (H-3) MISSION: EARTH-CENTERED RETURN-TO-EARTH CONIC SUBPROCESSOR

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01568

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-24

February 17, 1970

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 13 (MISSION H-2) LAUNCHED APRIL 11, 1970 VOLUME II - TRAJECTORY PARAMETERS

Lunar Mission Analysis Branch,

Orbital Mission Analysis Branch,

and Lunar Analysis Branch

MISSION PLANNING PLANNING AND ANALYSIS DIVISION

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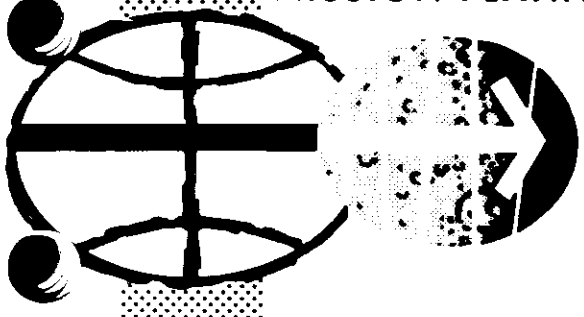

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MSC-01571

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

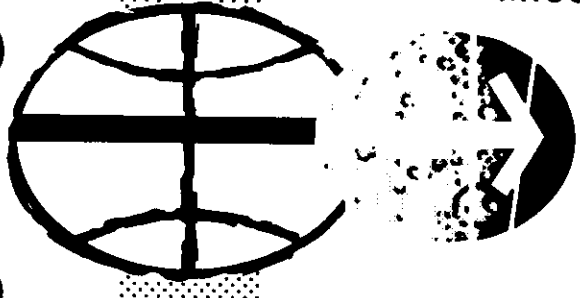
MSC INTERNAL NOTE NO. 70-FM-25

February 12, 1970

SATURN INTERMEDIATE-20 AND INTERMEDIATE-21 LAUNCH VEHICLE PERFORMANCE CAPABILITY

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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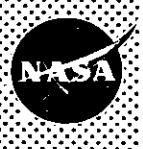
MSC-01594



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

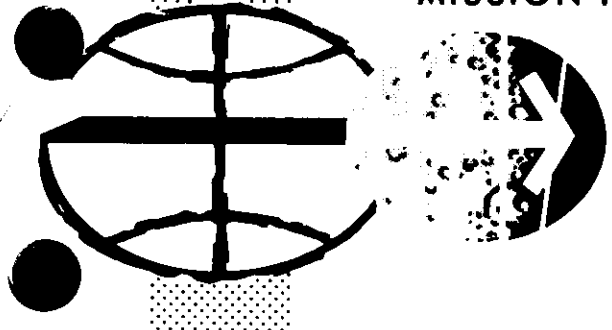
MSC INTERNAL NOTE NO. 70-FM-26

February 26, 1970

RTCC REQUIREMENTS FOR APOLLO 14: TRAJECTORY COMPUTERS FOR TLI AND MCC PROCESSORS

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: 70-FM54-123

... 5 1970

MEMORANDUM TO: See attached list

FROM : FM5/Chief, Lunar Mission Analysis Branch

SUBJECT : RTCC requirements for Apollo 14 (H-3): Trajectory computers for TLI and MCC processors - Change 1

Enclosed is Change 1 to MSC Internal Note No. 70-FM-26. This change reflects elimination of some redundant paths in the trajectory computers and some minor corrections to the original logic.

Ronald L. Berry

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

James C. Stokes, Jr., Chief
Flight Software Branch

Enclosure

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-26 (MSC-01594) DATED February 26, 1970

RTCC REQUIREMENTS FOR APOLLO 14: TRAJECTORY COMPUTERS FOR TLI AND MCC PROCESSORS

By Brady O. McCaffety, William E. Moore, and Quentin A. Holmes

Change 2

November 12, 1971

Ronald L. Berry, Chief
Planetary Mission Analysis Branch

for John P. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black bar in the margin indicates the area of change.

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Replace pages 43-44, 45-46, 65-66, and 67-68.

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MSC-01595

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-27

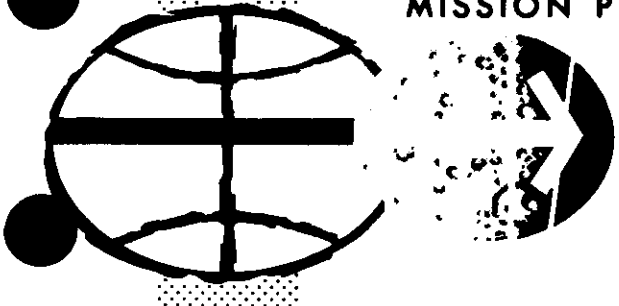
Feburary 17, 1970

OPERATIONAL ABORT PLAN FOR APOLLO 13 (MISSION H-2)

VOLUME II
LUNAR PHASE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01562

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-20

FEBRUARY 5,1970

THE APOLLO 11 ADVENTURE

(This document supersedes 69-FM-270)

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-01805

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-29

March 11, 1970

THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 13 (MISSION H-2) LAUNCHED APRIL 11, 1970 VOLUME I - MISSION PROFILE

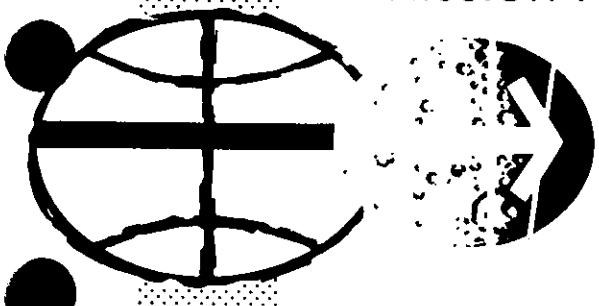
Orbital Mission Analysis Branch,

Lunar Mission Analysis Branch,

and

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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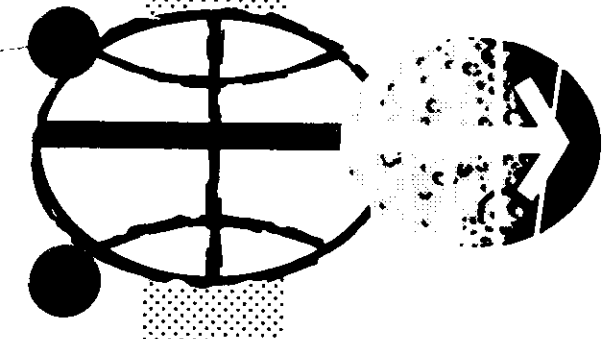
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-30

February 20, 1970

APOLLO 11 ENTRY

POSTFLIGHT ANALYSIS



LANDING ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

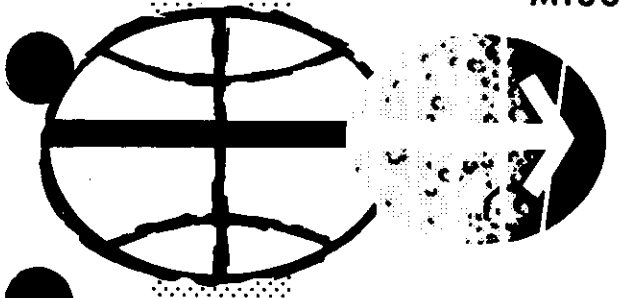
MSC INTERNAL NOTE NO. 70-FM-32

Feburary 26, 1970

OPERATIONAL ABORT PLAN FOR APOLLO 13 (MISSION H-2) VOLUME I - LAUNCH AND TRANSLUNAR PHASES

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-33

March 5, 1970

TRAJECTORY PREDICTION PARAMETERS FOR AAP, SPACE STATION/SPACE SHUTTLE, AND INTERPLANETARY MISSIONS

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

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MSC-01817

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

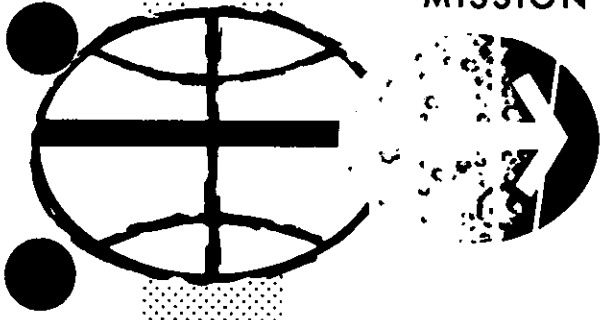
MSC INTERNAL NOTE NO. 70-FM-34

February 25, 1970

ABORT RESET POINTS FOR APOLLO 13

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01818

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

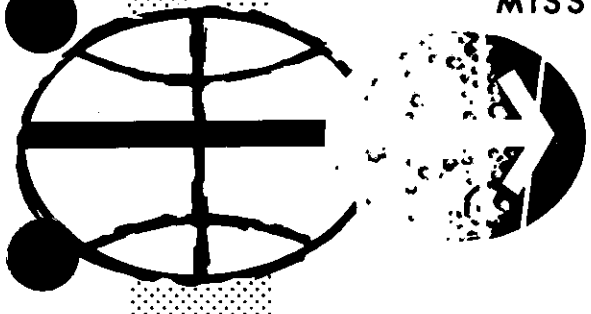
MSC INTERNAL NOTE NO. 70-FM-35

March 9, 1970

LOGISTICS VEHICLE ORBITAL TRAJECTORY CONSIDERATIONS AND TYPICAL MISSION PROFILES VOLUME III - ATTITUDE TIMELINES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-36

March 18, 1970

A DERIVATION OF THE ATTITUDE UPDATE EQUATION FOR A ROTATING BODY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

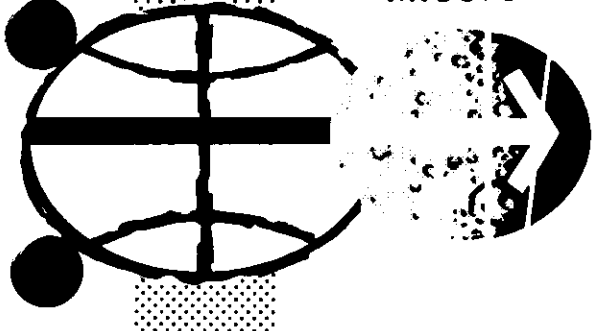
MSC INTERNAL NOTE NO. 70-FM-37

March 9, 1970

LAUNCH AND POLAR ORBIT TRANSFER VELOCITY REQUIREMENTS FOR THE LM-B (SPACE TUG)

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

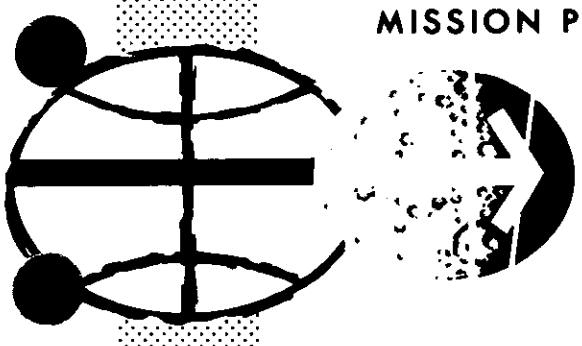
MSC INTERNAL NOTE NO. 70-FM-38

March 6, 1970

VIEWS FROM THE CM AND LM DURING THE FLIGHT OF APOLLO 13, LAUNCHED APRIL 11, 1970

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

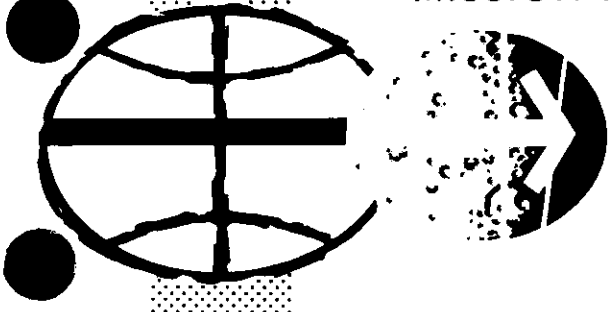
MSC INTERNAL NOTE NO. 70-FM-39

March 11, 1970

AAP SOFTWARE REQUIREMENTS: CMC RENDEZVOUS NAVIGATION PROGRAM

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-40

Feburary 27, 1970

APOLLO 13 (MISSION H-2)

CREW CHARTS

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

DATE March 3, 1970

MISSION: Apollo 13 (H2)

DOCUMENT: MSC IN 70-FM-40

TITLE: Apollo 13 (H2) Crew Charts

AMENDMENT No. 1

SHORT TITLE OF CHANGE: Amendment No. 1 to Apollo 13 (Mission H2) Crew Charts

CHANGE DESCRIPTION: See attached page.

APPROVED BY:

MSC FORM 295 (JULY 1969) OT

NARA SW Box E157G-47

TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

DATE March 10, 1970

MISSION: Apollo 13 (H2)

DOCUMENT: MSC IN 70-FM-40

TITLE: Apollo 13 (H2) Crew Charts

AMENDMENT No. 2

SHORT TITLE OF CHANGE: Amendment 2 to Apollo 13 (Mission H2) Crew Charts

CHANGE DESCRIPTION: See attached page.

APPROVED BY:

MSC FORM 295 (JULY 1969) OT

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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

DATE March 18, 1970

MISSION: Apollo 13 (H2)

DOCUMENT: MSC IN 70-FM-40

TITLE: Apollo 13 (H2) Crew Charts

AMENDMENT No. 3

SHORT TITLE OF CHANGE: Amendment 3 to Apollo 13 (Mission H2) Crew Charts

CHANGE DESCRIPTION: See attached page.

APPROVED BY: J. P. Porter

Carl R. Huss

MSC FORM 295 (JULY 1969) OT

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TRAJECTORY DOCUMENTATION CHANGE NOTIFICATION
MISSION PLANNING AND ANALYSIS DIVISION

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DATE March 27, 1970

MISSION: Apollo 13 (H2)

DOCUMENT: MSC IN 70-FM-4

TITLE: Apollo 13 (H2) Crew Charts

AMENDMENT 4

SHORT TITLE OF CHANGE: Amendment No. 4 to Apollo 13 (Mission H2) Crew Charts

CHANGE DESCRIPTION: See attached sheet

APPROVED BY: J P Parten

J L Rutherford

MSC FORM 295 (JULY 1969) OT

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MSC-01833

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-41

March 9, 1970

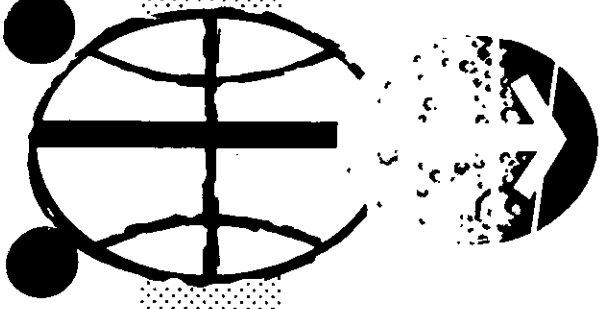
OPERATIONAL LM ABORT AND CSM RESCUE PLAN FOR APOLLO 13 (MISSION H-2)

VOLUME I - ABORTS FROM POWERED DESCENT AND ASCENT

TRW Systems Group

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-42

March 16, 1970

PRELIMINARY TRANSLATIONAL MANEUVER REQUIREMENTS FOR AN EARTH ORBIT TUG SUPPORTING A SPACE BASE BUILDUP AND OPERATIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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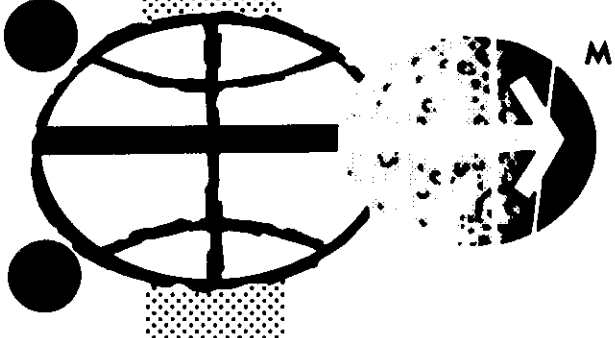
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-43

March 2, 1970

PRELIMINARY LUNAR ORBIT ATTITUDE SEQUENCE FOR APOLLO 13 (MISSION H-2)



Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-44

March 12, 1970

LOGIC AND EQUATIONS USED TO COMPUTE THE LIFT-OFF TIME FOR THE EARLY RENDEZVOUS PROFILE OF APOLLO 14 AND SUBSEQUENT MISSIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

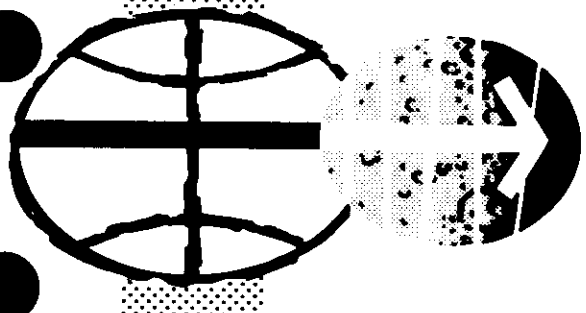
MSC INTERNAL NOTE NO. 70-FM-45

March 18, 1970

SEPARATION PROCEDURES FOR APOLLO 13 (MISSION H-2) AND SUBSEQUENT NOMINAL, ALTERNATE, AND ABORT MISSIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-45 DATED MARCH 18, 1970

(SEPARATION PROCEDURES FOR APOLLO 13 (MISSION H-2)

AND SUBSEQUENT NOMINAL, ALTERNATE, AND ABORT MISSIONS

By M. L. Williamson and C. W. Fraley

Change 1

Robert H. Brown, Acting Chief
Flight Analysis Branch

John R. Mayer, Chief
Mission Planning and Analysis Division

Page 1 of 44
(with enclosures)

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacements, have been inserted, place this CHANGE SHEET between the cover and title page and write on the cover "CHANGE 1 inserted:.

1. Replace pages xvii, 2 through 6, 15, 16, 22, 23, 39, 47, 48, 51 through 56, 58 through 61, 68 through 88, 92 through 98, 100, 102, 104, 106 through 111, 148, 149, 150, 152, 161, 171, 175.

2. Add page 74a.

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APOLLO 14 (MISSION H-3)

CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-45 DATED MARCH 18, 1970

SEPARATION PROCEDURES FOR APOLLO 13 (MISSION H-2)

AND SUBSEQUENT NOMINAL, ALTERNATE, AND ABORT MISSIONS

By M. L. Williamson and C. W. Fraley

Change 2

November 24, 1970

Robert H. Brown, Chief
Flight Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacements, have been inserted, place this CHANGE SHEET between the cover and title page and write on the cover "CHANGE 2 inserted".

1. Replace pages iii, v through xvii, 52 through 61, 68 through 110, 113, 116 through 123, 125 through 135, 138, 139, 144, 147, 148 through 152, 164, 167, 168, 170, 171, 179 through 183.

2. Add pages xviii, 90a, 169a through 169m.

3. Delete pages 131, 132, 136, 137, 142, 143, 145, 159, 160.

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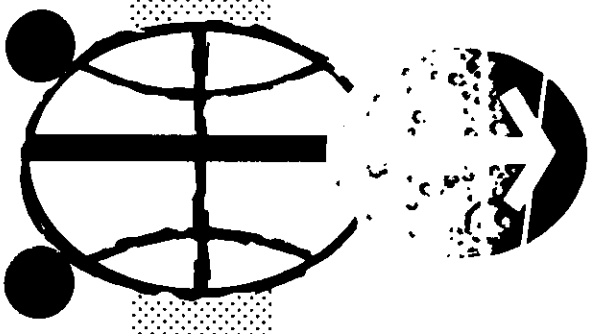
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-28

March 20, 1970

POSTFLIGHT EVALUATION OF THE APOLLO 12 SPACECRAFT TRAJECTORY

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01843

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

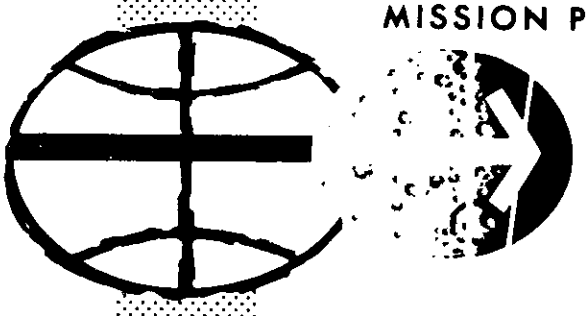
MSC INTERNAL NOTE NO. 70-FM-48

March 27, 1970

REENTRY TARGETING PHILOSOPHY AND FLIGHT RESULTS FROM APOLLO 10 AND 11

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

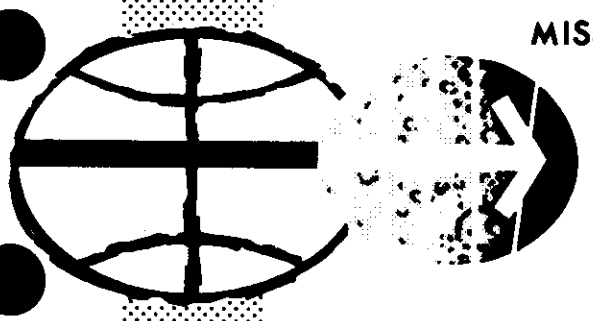
MSC INTERNAL NOTE NO. 70-FM-49

March 9, 1970

RECOMMENDED ENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR APOLLO 13 (MISSION H-2)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-50

March 20, 1970

APOLLO 13 (MISSION H-2) SPACECRAFT DISPERSION ANALYSIS

VOLUME IV

DESCENT AND ASCENT DISPERSION ANALYSES

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

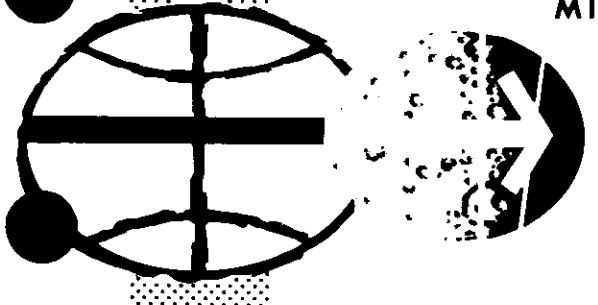
MSC INTERNAL NOTE NO. 70-FM-52

MARCH 23, 1970

DESCRIPTION OF THE SHORT ASCENT AND RENDEZVOUS MONITOR DISPLAY PROCESSOR TO BE USED ON APOLLO 14 AND SUBSEQUENT MISSIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-53

April 2, 1970

APOLLO 12 ENTRY POSTFLIGHT ANALYSIS

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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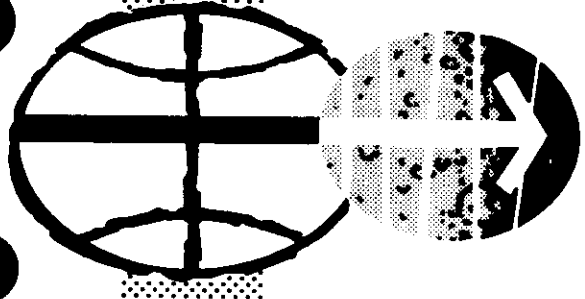
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-54

March 24, 1970

APOLLO 13 (MISSION H-2)
SPACECRAFT DISPERSION ANALYSIS
VOLUME VII - DISPERSION SUMMARY

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

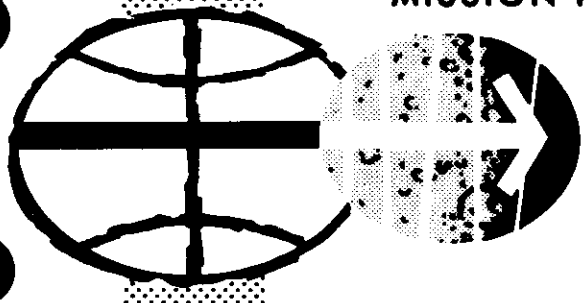
MSC INTERNAL NOTE NO. 70-FM-55

March 31, 1970

DESCENT TRAJECTORY: A PRIORI TERRAIN AND PREFILTER STUDY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

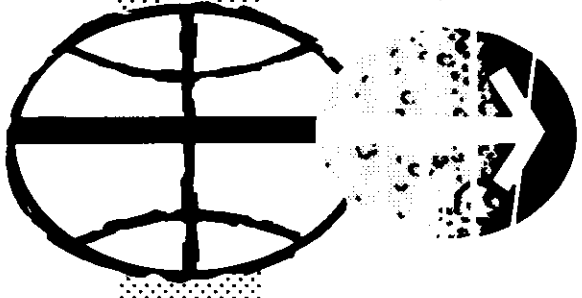
MSC INTERNAL NOTE NO. 70-FM-56

April 8, 1970

PRELIMINARY PROGRAM DESIGN SPECIFICATIONS FOR SPACE STATION AND SHUTTLE TWO-WAY DOPPLER ONBOARD NAVIGATION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

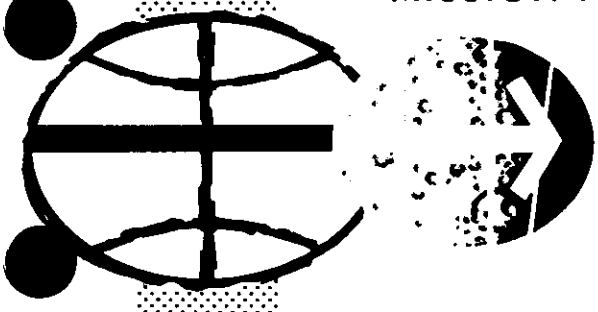
MSC INTERNAL NOTE NO. 70-FM-57

March 31, 1970

SENSITIVITY OF ΔRLS (NOUN 69) COMPUTATIONS TO FLIGHT-PATH ANGLE ERROR

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-58

March 27, 1970

APOLLO 14 (MISSION H-3)
BASELINE MISSION PROFILE

(This revision supersedes MSC Internal Note No. 69-FM-328 dated December 31, 1969.)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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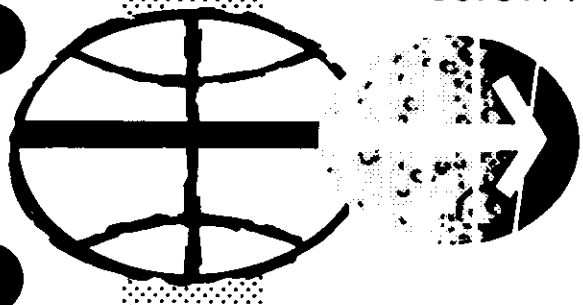
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-59

March 23, 1970

THE CONSUMABLES ANALYSIS FOR THE APOLLO 13 (MISSION H-2) SPACECRAFT OPERATIONAL TRAJECTORY; APRIL 11, 1970, LAUNCH DATE

Guidance And Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION



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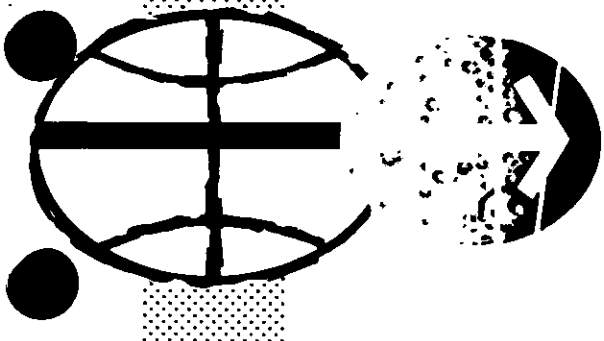
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-60

March 30, 1970

LM DESCENT ΔV REQUIREMENTS FOR PINPOINT LANDINGS

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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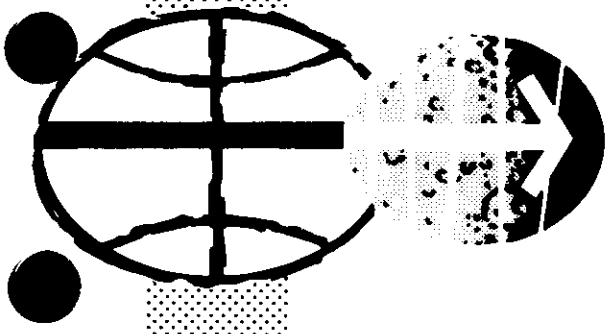
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-61

April 7, 1970

PARAMETRIC TRAJECTORY ANALYSIS OF THE 1986 MARS CONJUNCTION CLASS MISSION, USING TWO- AND THREE-IMPULSE TRANS-MARS TRAJECTORIES

Advanced Mission Design Branch
MISSION PLANNING AND ANALYSIS DIVISION



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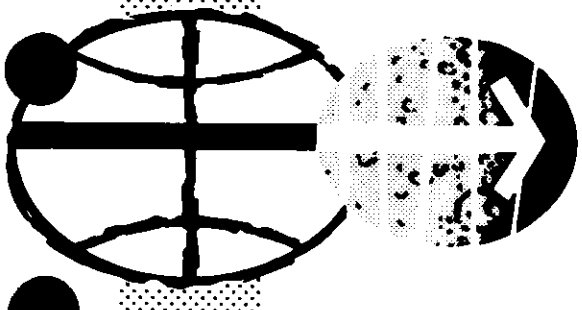
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-62

APRIL 8, 1970

LAUNCH WINDOW AND TRANSLUNAR, LUNAR ORBIT, AND TRANSEARTH TRAJECTORY PLANNING AND CONTROL FOR THE APOLLO 11 LUNAR LANDING MISSION

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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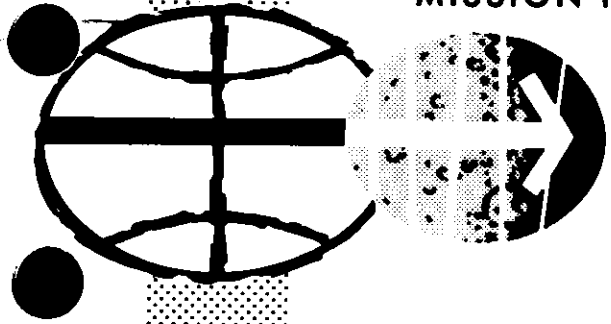
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-63

April 7, 1970

ENVIRONMENTAL CONTROL SYSTEM CONSUMABLES REQUIREMENTS FOR THE MARCH 15, 1972 SKYLAB BASELINE REFERENCE MISSIONS

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01894

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-64

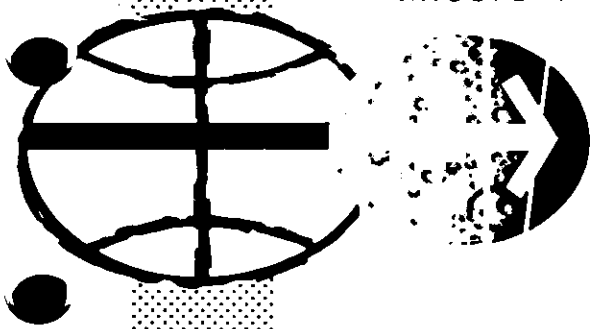
March 31, 1970

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 13 (MISSION H-2) LAUNCHED APRIL 11, 1970 VOLUME II - TRAJECTORY PARAMETERS

REVISION 1

Lunar Mission Analysis Branch,
Orbital Mission Analysis Branch,
and
Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01895

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-65

April 6, 1970

RTCC OFFLINE REQUIREMENTS FOR H-3: LM POSITION DETERMINATION USING AOT + G MEASUREMENTS ON LUNAR SURFACE

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E157G-48

CHANGE HISTORY FOR 70-FM-65

Change no.	Date	Description
1	5/18/70	Page 2: Pen-and-ink change to add symbol and definition to list of symbols Page 5: Replaced page to correct equation to read $K\sqrt{(\Delta\phi)^2 + (\Delta\lambda)^2} < \text{INPUT (ft)}$ and to correct phrasing in paragraph following the equation Page 7: pen-and-ink changes to correct units and definitions Page 9: pen-and-ink change to add word for clarification Page 13: pen-and-ink change to change wording for clarification Page 17: pen-and-ink change to add word for clarification Pages 21 and 22: replaced pages to correct flow charts

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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO
ATTN OF: FM4 (71-63)

MAY 6 1971

MEMORANDUM

TO: See List Below

FROM: FM/Mission Planning and Analysis Division

SUBJECT: Change 2 to Internal Note No. 70-FM-65, "RTCC Offline Requirements for H-3: LM Position Determination Using AOT + G Measurement on Lunar Surface"

Reference: MSC Internal Note No. 70-FM-65, "RTCC Offline Requirements for H-3: LM Position Determination Using AOT + G Measurements on Lunar Surface," FM4/T. J. Blucker, TRW/B. M. Most, April 6, 1970.

The attached defines the change 2 to be incorporated into the RTCC offline program AOT + G. These pages should be substituted into the reference to represent the current program definition.

The changes are necessary due to the change made in the LM onboard alinement program which alters the AOT marking procedures for Apollo 15 and subsequent missions. The Apollo 15 program takes all spiral data then all cursor data, storing a mark time for each mark. The new RTCC formulation must form a marking set (spiral + cursor) and correct for lunar rotation between the two marks. The present RTCC program capability will be retained, and this option will be selected when only one set of gimbal angles and one mark time are input for each set of cursor and spiral angles as the old marking sequence is still available in the LM computer.

Emil R. Schiesser
Assistant Chief
Mathematical Physics Branch

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MSC-01841

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

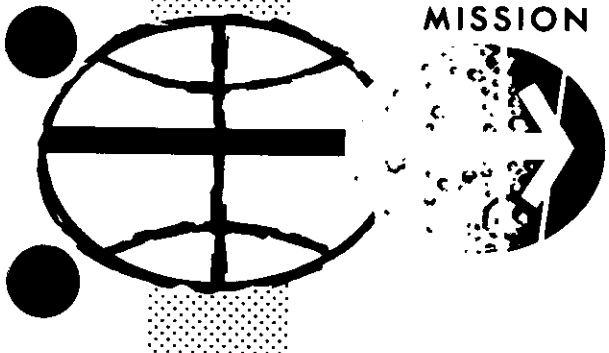
MSC INTERNAL NOTE NO. 70-FM-47

March 25, 1970

APOLLO LUNAR RENDEZVOUS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01898

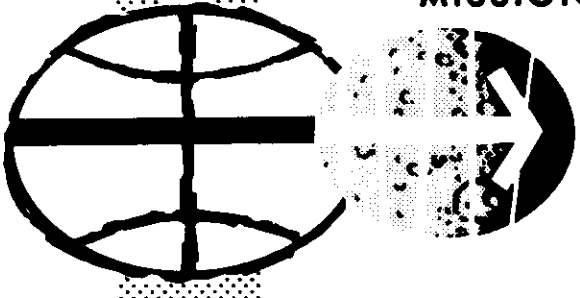
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-67

April 23, 1970

APOLLO ORBIT DETERMINATION AND NAVIGATION

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01899

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-68

April 22, 1970

LAUNCH WINDOW SCANS AND ASSOCIATED MISSION PLANNING DATA FOR 1971

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-02400

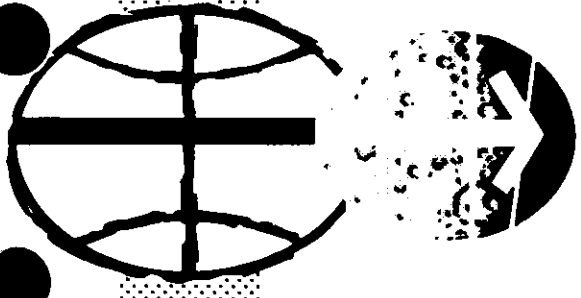
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-69

April 30, 1970

STATISTICS OF STATE-VECTOR CORRECTIONS FOR APOLLO ONBOARD COMPUTERS

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02401

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-70

April 13, 1970

1981-1982 MARS ROUND-TRIP ORBITAL MISSIONS USING TWO-IMPULSE, THREE-IMPULSE, AND VENUS-SWINGBY TRAJECTORIES: 45 000-FPS EARTH-ENTRY CAPABILITY

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-02403

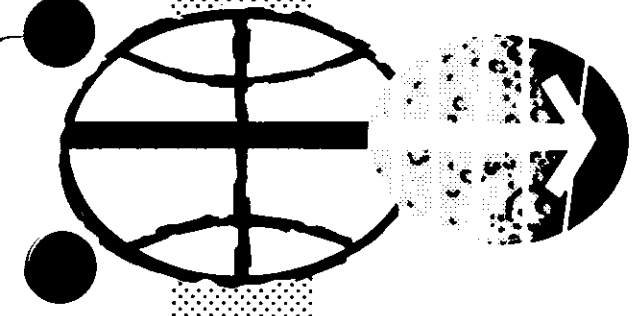
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-71

April 2, 1970

ENTRY MISSION PLAN - APOLLO 13 (MISSION H-2)

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02404

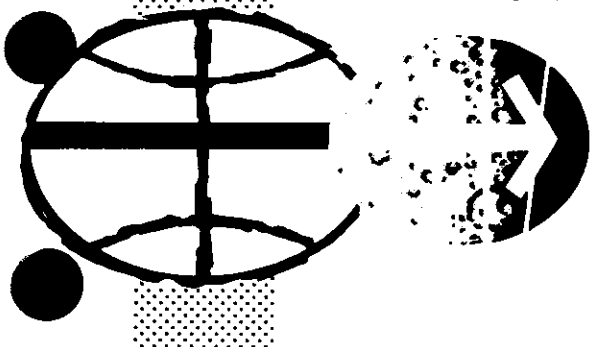
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-72

APRIL 1, 1970

FINAL CONSUMABLES SUMMARY FOR THE APOLLO 13 MISSION

Guidance and Performance Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02405

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

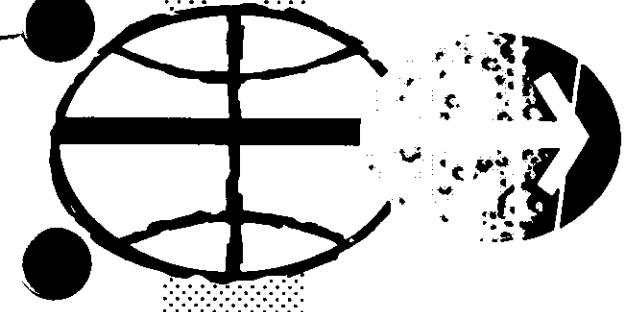
MSC INTERNAL NOTE NO. 70-FM-73

April 2, 1970

OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR APOLLO 13 (MISSION H-2)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02407

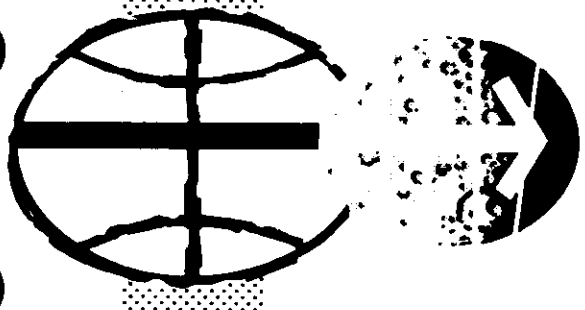
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-74

April 6, 1970

LM LANDING PHASE MANUAL TRANSLATIONAL CAPABILITY

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02408

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

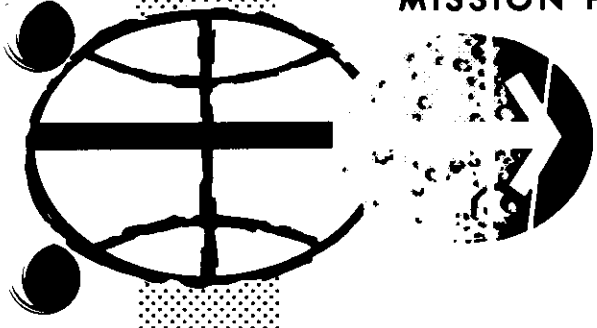
MSC INTERNAL NOTE NO. 70-FM-75

April 22, 1970

FIRST-ORDER SOLUTION TO ERRORS ON INDIVIDUAL MEASUREMENTS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02409

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-76

April 15, 1970

ABORT PLANNING FOR APOLLO MISSIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-02411

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

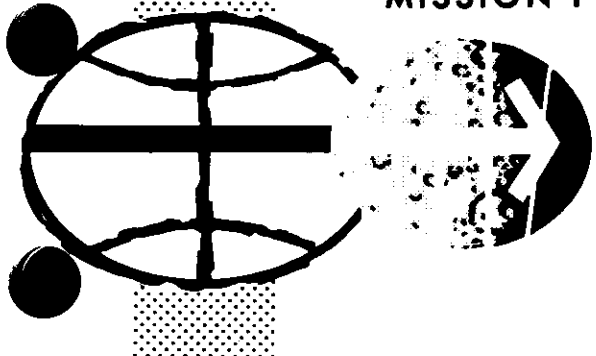
MSC INTERNAL NOTE NO. 70-FM-77

April 9, 1970

APOLLO 13

NAVIGATION PROCEDURES

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02415

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

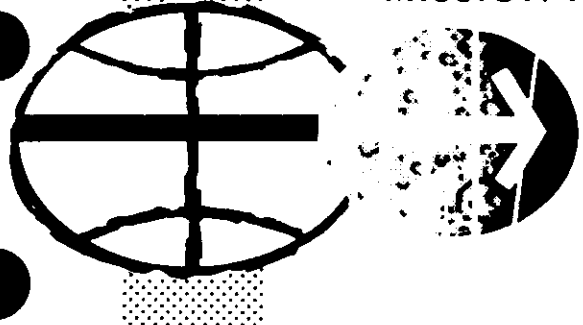
MSC INTERNAL NOTE NO. 70-FM-78

April 8, 1970

APOLLO 13

LUNAR TRAJECTORY NOTES

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02418

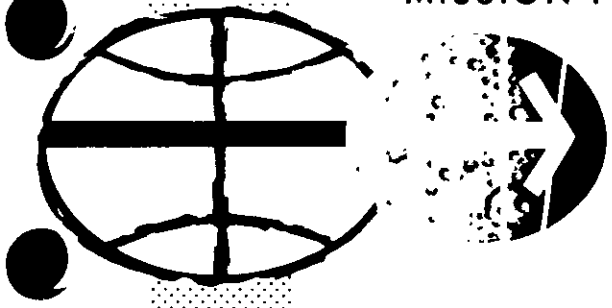
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-79

April 13, 1970

GROUND-CONTROLLED INSERTION: A MANUAL GUIDANCE TECHNIQUE FOR LM ASCENT AND ABORT FROM DESCENT

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02419

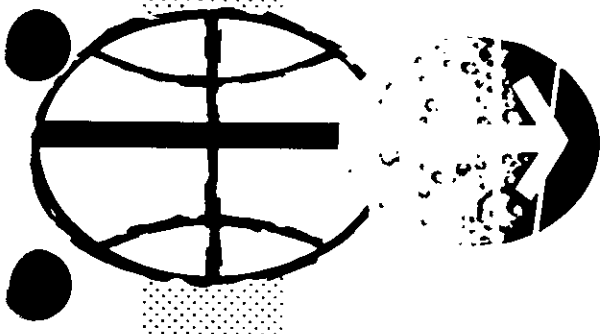
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-80

April 21, 1970

LUNAR DESCENT AND ASCENT TRAJECTORIES

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02421

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

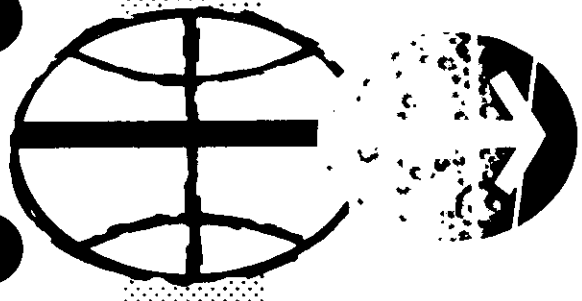
MSC INTERNAL NOTE NO. 70-FM-81

April 29, 1970

RTCC REQUIREMENTS FOR APOLLO 15 (MISSION H-4): LOI TARGETING

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02425

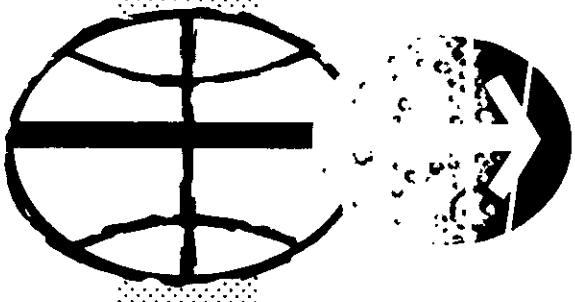
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-82

April 24, 1970

PREDICTED LAUNCH ABORT LANDING POINT DATA COMPUTED FOR APOLLO 13

Mission Planning Support Office
MISSION PLANNING AND ANALYSIS DIVISION



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CHANGE HISTORY FOR 70-FM-82

Change no.	Date	Description
1	5/4/70	Page 98: Added page to include references

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MSC-02435

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

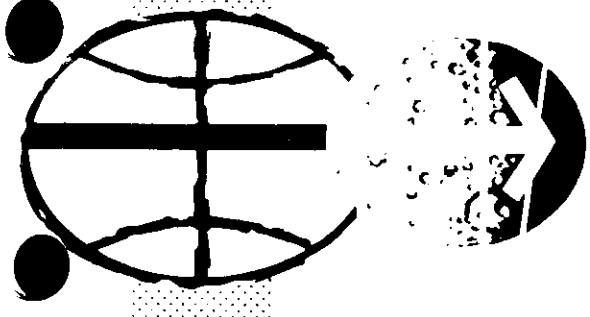
MSC INTERNAL NOTE NO. 70-FM-83

May 5, 1970

INEQUALITY CONSTRAINTS IN PRIMER OPTIMAL, N-IMPULSE SOLUTIONS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02442

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

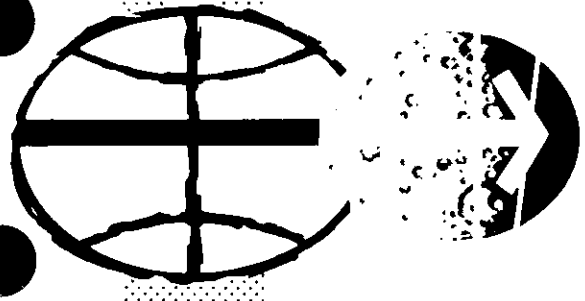
MSC INTERNAL NOTE NO. 70- FM-84

May 6, 1970

SKYLAB ELECTRICAL POWER SUBSYSTEM BASELINE REFERENCE MISSION ANALYSIS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-01896

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

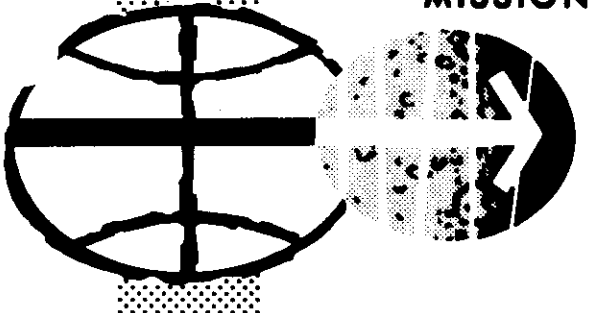
MSC INTERNAL NOTE NO. 70-FM-66

APRIL 9, 1970

REFERENCE MISSION: 1981 MARS LANDING WITH INBOUND VENUS SWINGBY

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02448

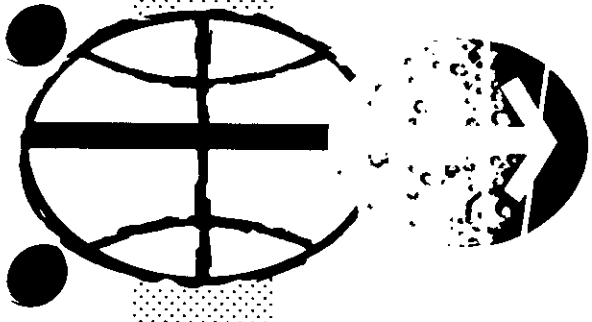
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-87

May 13, 1970

DEVELOPMENT AND ANALYSIS OF PRELIMINARY SCHEDULES FOR AN ADVANCED LUNAR TRANSPORTATION SYSTEM

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02501

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

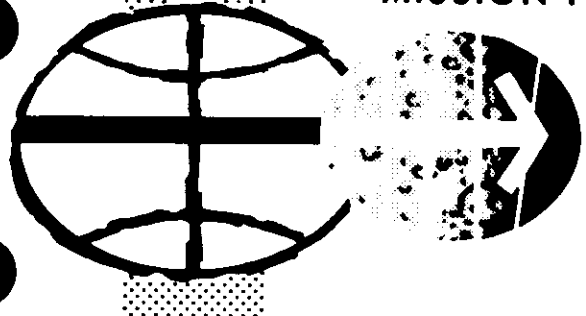
MSC INTERNAL NOTE NO. 70-FM-89

May 18, 1970

A CATALOG OF ROUND-TRIP MARS ORBITAL MISSIONS IN THE 1980'S

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-02500

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-90

May 15, 1970

VIEWS FROM THE RETURNING APOLLO 13 SPACECRAFT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

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MSC-02503

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-91

May 18, 1970

EXPECTED LOAD FACTOR MAGNITUDE AND DURATION FOR A NOMINAL SHUTTLE ENTRY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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[illegible] CONTROL
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MSC-02504

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

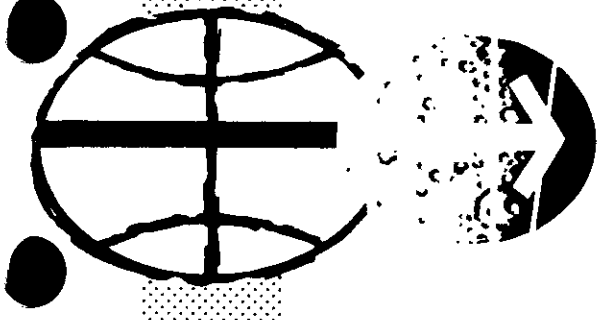
MCS INTERNAL NOTE NO. 70-FM-92

June 15, 1970

REVISION 1 TO THE RTCC REQUIREMENTS FOR MISSION G: MSFN TRACKING DATA PROCESSOR FOR POWERED FLIGHT LUNAR ASCENT/DESCENT NAVIGATION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-92 DATED JUNE 15, 1970

REVISION 1 TO THE RTCC REQUIREMENTS FOR MISSION G:

MSFN TRACKING DATA PROCESSOR FOR POWERED FLIGHT

LUNAR ASCENT/DESCENT NAVIGATION

By W. M. Lear, TRW Systems Group, and Howard G. deVezin, Jr.,
Alan D. Wylie, and Emil R. Schiesser, Mathematical Physics Branch

Change 2

February 12, 1971

James C. McPherson, Chief
Mathematical Physics Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacement pages, have been inserted, place this CHANGE SHEET between the cover and title page and write on the cover, "CHANGE 2 inserted".

1. Replace pages 61, 103, 105.

2. Add page 61a.

NARA SW Box E157G-50

Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF: 71-FM47-36

MAR 1 0 1971

MEMORANDUM TO: See List Below

FROM : FM/Mission Planning and Analysis Division

SUBJECT : RTCC Requirements for Apollo 15: Change to the refraction formulation implemented into the powered flight processor for Apollo 15

1. Reference: MSC Memorandum No. 70-FM47-231, "RTCC Requirements for Apollo 15: Changes in formulation to the powered flight processor for Apollo 15," FM4/A. D. Wylie, October 1, 1970.

2. Attached are corrections to the refraction formulation implemented into the powered flight processor (PFP) for Apollo 15. The original changes are presented in the reference.

3. One correction involves changing a constant used to compute a program index used in the refraction equations. The other correction avoids a division-by-zero in the equations when less than four radar tracking sites are specified for processing.

4. The changes correct errors in the formulation of the reference and do not introduce any new program concepts. IBM has made the necessary changes to the RTCC formulation.

Emil R. Schiesser
Assistant Chief
Mathematical Physics Branch

The Flight Software Branch concurs with the above recommendation and requests IBM to proceed accordingly.

Larry J. Dungan for
James C. Stokes, Jr., Acting Chief
Flight Software Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Attachment

Distribution: (See attached list)

FM4:ADWylie:fdt

NARA SW Box E157G-50

Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: FM47-231

OCT 1 1970

MEMORANDUM TO: See list below

FROM : FM4/Assistant Chief, Mathematical Physics Branch

SUBJECT : RTCC Requirements for Apollo 15: Changes in formulation of the powered flight processor for Apollo 15

1. Reference: MSC Internal Note 70-FM-92, "Revision 2 to the RTCC Requirements for Mission G: MSFN Tracking Data Processor for Powered Ascent/Descent Navigation;" W. M. Lear, FM4; F. G. deVezin, [illegible], E. R. Schlesser, Mathematical Physics Branch; June 15, 1970.

2. Attached are the changes in formulation to the powered flight processor (PFP) for Apollo 15. The current formulation for the PFP is contained in the reference. The changes include the following:

a. A new rate error model which improves the ability of the filter to maintain an accurate estimate of LM position and makes the program less sensitive to tracking station geometry in obtaining the optimum set of filter weights for an Apollo mission.

b. Formulation to process Doppler resolver data. The resolver data decreases the granularity error in the Doppler observations and results in an improved determination of LM position and velocity by the filter.

c. Formulation to include the effect of atmospheric refraction on tracking observations. This new formulation will allow the minimum elevation angle criteria for processing data from a MSFN site to be [illegible] from 10° to 5°.

d. Formulation to provide independent weights for descent and ascent for the mass flow rate uncertainty. The independent weights provide a more accurate solution in each phase and also make the program less sensitive to tracking station geometry.

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MSC-02505

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-93

June 15, 1970

RTCC OFFLINE REQUIREMENTS FOR H-3: LUNAR SURFACE STAR SELECTION PROCESSOR

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: 70-FM47-197

AUG 27 1970

MEMORANDUM TO: See list below

FROM : FM/Mission Planning and Analysis Division

SUBJECT : Change to Offline RTCC Lunar Surface Star Selection Processor for Apollo 14

1. Reference: MSC Internal Note 70-FM-93, "RTCC Offline Requirements for H-3 Lunar Surface Star Selection Processor," T. J. Blucker, MPB, and B. Most and J. Dashiell, TRW, June 15, 1970.

2. The attached defines change one to the reference. This change should be included in the offline RTCC documentation and program coding of the lunar surface star selection processor.

Emil R. Schiesser
Assistant Chief
Mathematical Physics Branch

The Flight Software Branch concurs with the above recommendation and requests IBM to proceed accordingly.

James C. Stokes, Jr., Chief
Flight Software Branch

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

Attachment

cc: (See attached list)

FM4:TJBlucker:rmr

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MSC-02510

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

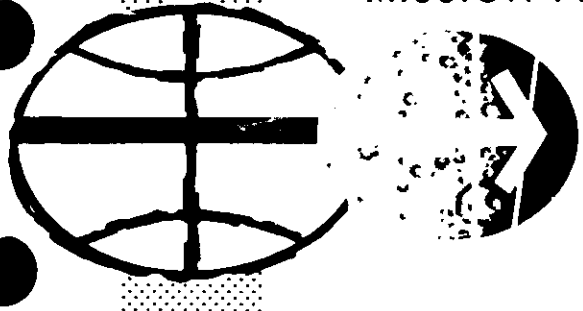
MSC INTERNAL NOTE NO. 70-FM-94

May 28, 1970

SIMULATOR DATA PACKAGE FOR SKYLAB 1/2

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

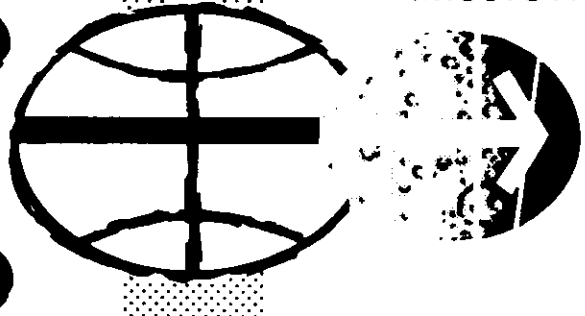
MSC INTERNAL NOTE NO. 70-FM-95

MAY 27, 1970

AN ENTRY GUIDANCE CONCEPT WITH SHUTTLE APPLICATIONS

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-95 DATED MAY 27, 1970

AN ENTRY GUIDANCE CONCEPT

WITH SHUTTLE APPLICATIONS

By R. M. Edwards and J. C. Harpold

Change 1

June 19, 1970

Floyd V. Bennett, Chief
Landing Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

Note: A black bar in the margin indicates the area of change.

After the atached enclosures, which are replacement pages, have been inserted, and after the following pen-and-ink changes have been made, place this CHANGE SHEET between the cover and title page and write on the cover, "CHANGE 1 inserted".

1. On page 3, change the footnote marker on the variable D_{low} from "A" to "a".

2. On page 9, add the footnote marker "a" for the variable Y.

3. On page 35, change equation (A3) to read ...

$$[\bar{u}_n \cos \phi + \bar{u}_z \sin \phi].$$

4. On page 41, in equation (A54) change the $-H/H_s$ term to $-\dot{H}/H_s$.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

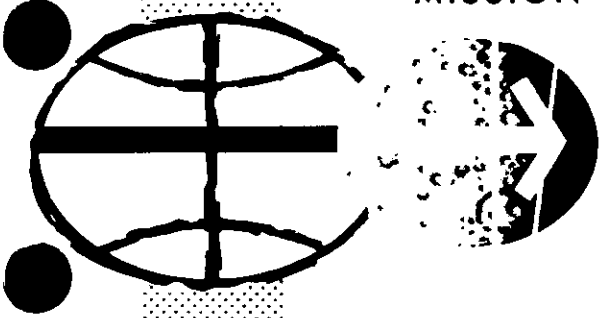
MSC INTERNAL NOTE NO. 70-FM-96

June 25, 1970

AN EARTH DEPARTURE TECHNIQUE FOR USE IN MANNED INTERPLANETARY MISSIONS USING THE NERVA ENGINE

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

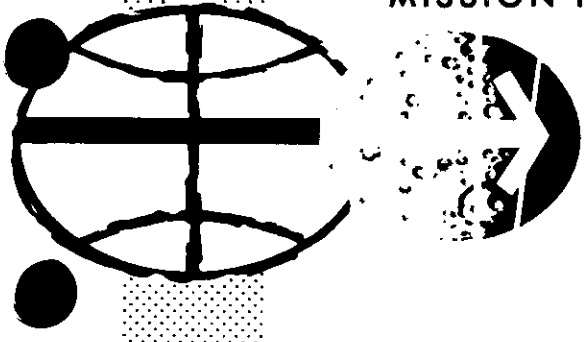
MSC INTERNAL NOTE NO. 70-FM-97

June 6, 1970

NAVIGATION FOR THE APOLLO 12 LUNAR LANDING

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

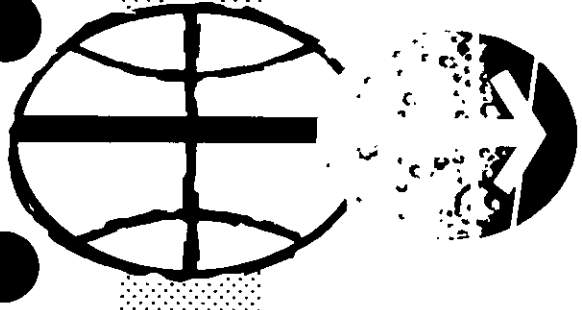
MSC INTERNAL NOTE NO. 70-FM-98

June 6, 1970

LM DESCENT MANUAL
THROTTLE-DOWN TECHNIQUE

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

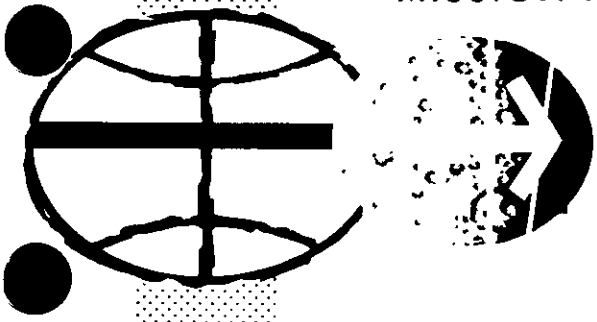
MSC INTERNAL NOTE NO. 70-FM-99

June 9, 1970

PROPULSION SYSTEMS CONSUMABLES REQUIREMENTS FOR THE JULY 19, 1972, SKYLAB BASELINE REFERENCE MISSIONS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-100

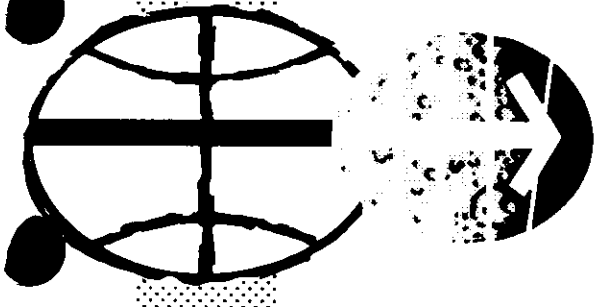
June 15, 1970

SKYLAB ELECTRICAL POWER SUBSYSTEM

PARAMETRIC ANALYSIS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-102

June 18, 1970

SKYLAB ATMOSPHERIC CONTROL AND EQUIPMENT COOLING PARAMETRIC STUDIES

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

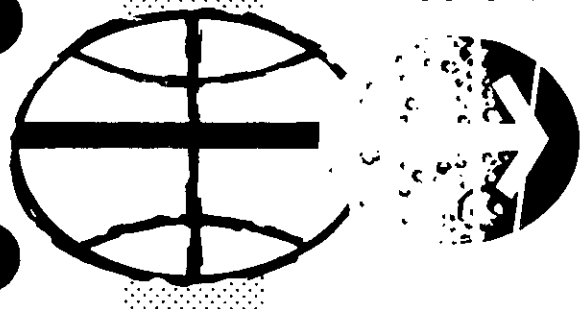
MSC INTERNAL NOTE NO. 70-FM-103

June 25, 1970

A SIMPLE SIX-DEGREE-OF-FREEDOM DIGITAL AUTOPILOT SIMULATION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

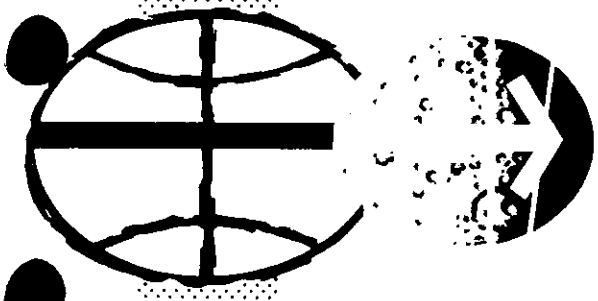
MSC INTERNAL NOTE NO. 70-FM-104

June 23, 1970

TYPICAL SHUTTLE MISSION PROFILES AND ATTITUDE TIMELINES VOLUME I - SPACE STATION RESUPPLY MISSIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 70-FM-105

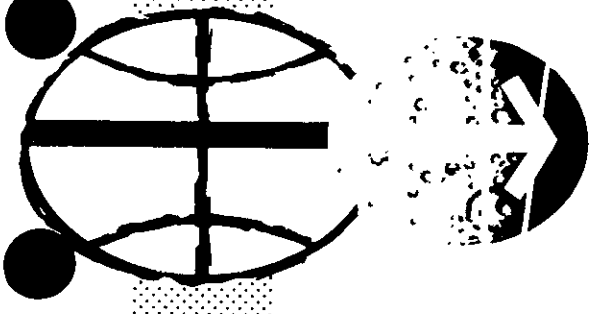
July 29, 1970

EXPERIENCE REPORT:

EVOLUTION OF THE ATTITUDE TIMELINE

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

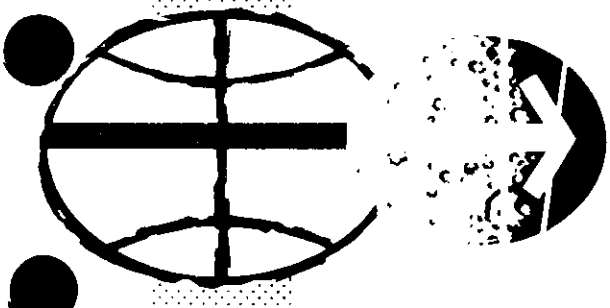
MSC INTERNAL NOTE NO. 70-FM-106

June 26, 1970

POSITION OF LUNAR HORIZON IN LM OVERHEAD WINDOW DURING ASCENT

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

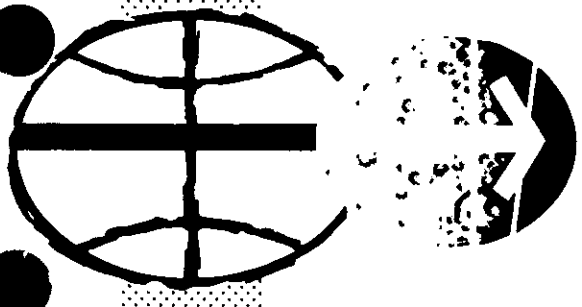
MSC INTERNAL NOTE NO. 70-FM-107

July 14, 1970

CHARACTERISTICS OF ORBITER STAGE OF EARTH-ORBITAL SHUTTLE FOR AN UNPOWERED LANDING

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

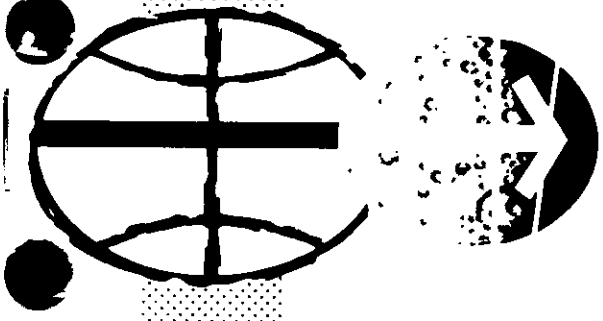
MSC INTERNAL NOTE NO. 70-FM-108

July 1, 1970

CHARACTERISTICS OF HIGH-ENERGY, FAST GRAND TOUR TYPES OF MISSIONS TO THE OUTER PLANETS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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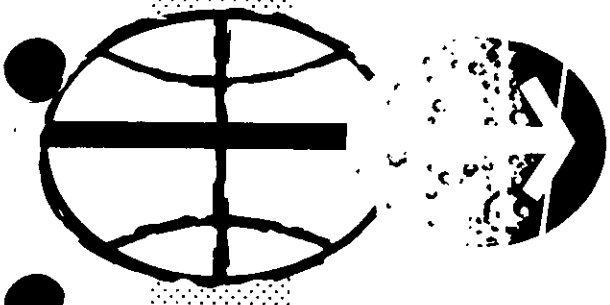
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-109

July 7, 1970

MPAD REAL-TIME SUPPORT OF THE APOLLO 13 MISSION

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-86

May 28, 1970

TRAJECTORY PREDICTION PARAMETERS FOR SKYLAB, SPACE STATION/SPACE SHUTTLE, AND INTERPLANETARY MISSIONS

Mathematical Phyics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

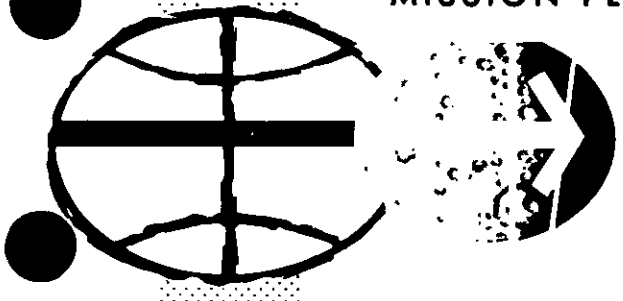
MSC INTERNAL NOTE NO. 70-FM-111

July 7, 1970

EARTH ATMOSPHERIC ENTRY FOR REFERENCE MISSION - 1981 MARS LANDING WITH INBOUND VENUS SWINGBY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

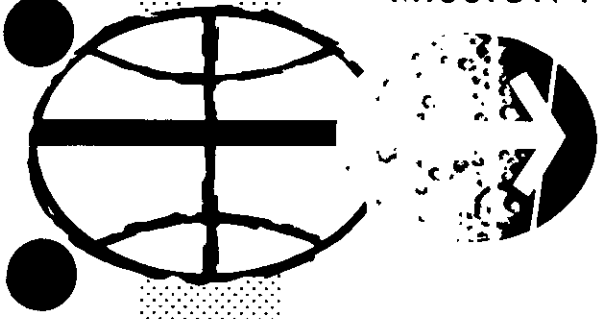
MSC INTERNAL NOTE NO. 70-FM-112

July 16, 1970

CONSUMABLES ANALYSIS TECHNIQUES FOR THE SERVICE PROPULSION SUBSYSTEM

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

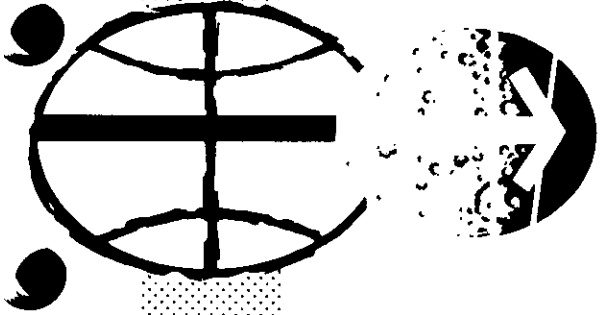
MSC INTERNAL NOTE NO. 70-FM-113

August 12, 1970

PROPOSED ITERATIVE GUIDANCE MODE (IGM) EQUATIONS FOR THE SHUTTLE LAUNCH GUIDANCE

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 70-FM-114

July 31, 1970

APPROACH AND LANDING CONSIDERATIONS FOR AN UNPOWERED ORBITER

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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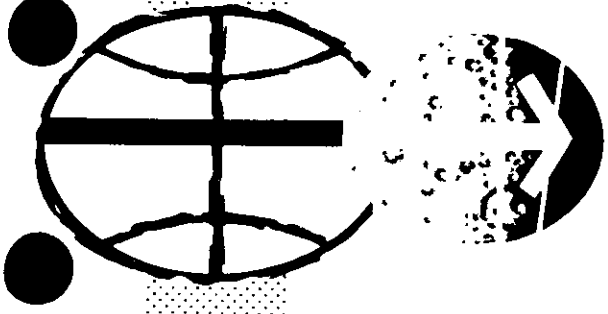
MSC INTERNAL NOTE NO. 70-FM-115

July 23, 1970

PRELIMINARY J-TYPE ATTITUDE SEQUENCE - SIM PERIOD

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-116

July 23, 1970

STUDY OF SKYLAB ECS REQUIREMENTS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-117

July 28, 1970

PRELIMINARY CSM MISSION PROFILE FOR A TYPICAL J-TYPE MISSION

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

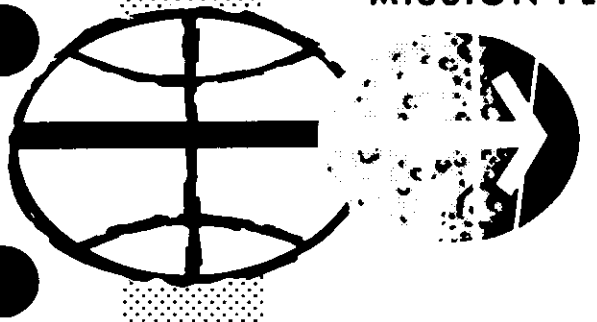
MSC INTERNAL NOTE NO. 70-FM-118

July 30, 1970

A PRELIMINARY ANALYSIS OF THE MDA RADIATOR FOR SKYLAB

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

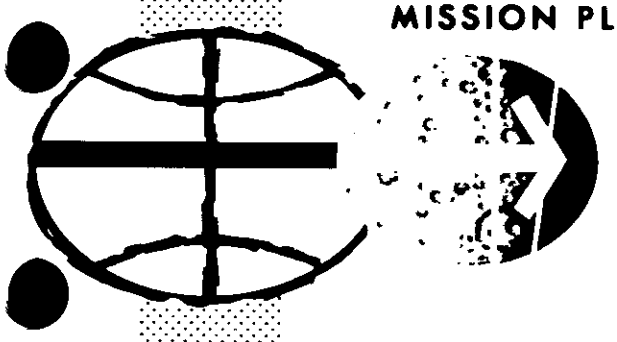
MSC INTERNAL NOTE NO. 70-FM-119

August 11, 1970

SKYLAB ELECTRICAL POWER SUBSYSTEM DISTRIBUTION NETWORK ANALYSIS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-120

August 12, 1970

THE LOGISTICS OF SOME POSSIBLE ADVANCED LUNAR TRANSPORTATION SYSTEMS SUPPLYING A LUNAR ORBIT SPACE STATION

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-02446

Revision 1

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-121

August 31, 1970

TRAJECTORY PREDICTION PARAMETERS FOR SKYLAB, SPACE STATION/SPACE SHUTTLE, AND INTERPLANETARY MISSIONS

REVISION 1

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-02616

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-122

August 17, 1970

APOLLO EXPERIENCE REPORT: DEVELOPMENT OF THE APOLLO SPACECRAFT SEPARATION AND RECONTACT ANALYSES

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-02617

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

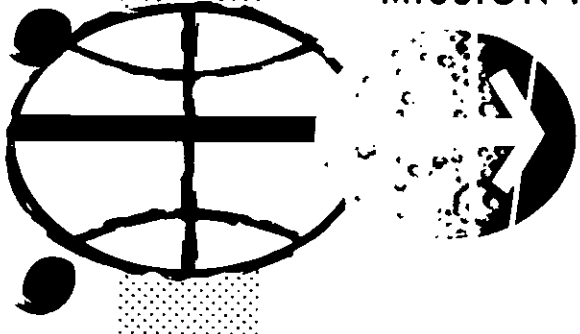
MSC INTERNAL NOTE NO. 70-FM-123

August 11, 1970

A TYPICAL GUIDED ENTRY REFERENCE TRAJECTORY FOR THE MSC DC-3, CONFIGURATION 002, ORBITER SHUTTLE VEHICLE

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-124

September 8, 1970

CHARACTERISTICS OF FAST GRAND TOUR TRAJECTORIES NEAR SATURN

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-02624

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

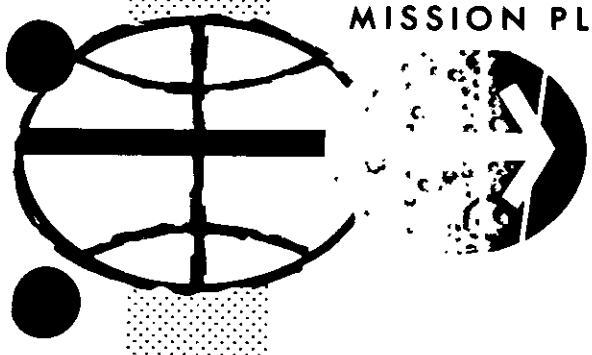
MSC INTERNAL NOTE NO. 70-FM-125

August 24, 1970

A PRELIMINARY LOGISTICS PLAN TO SUPPLY OXYGEN TO THE INTERPLANETARY MODULE IN A HIGH EARTH ORBIT FROM THE LUNAR SURFACE GENERATION SOURCE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

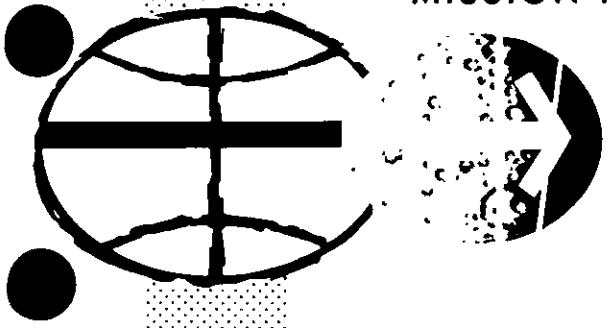
MSC INTERNAL NOTE NO. 70-FM-126

September 3, 1970

DERIVATION OF THE FP-7 LM AGS FILTER EQUATIONS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

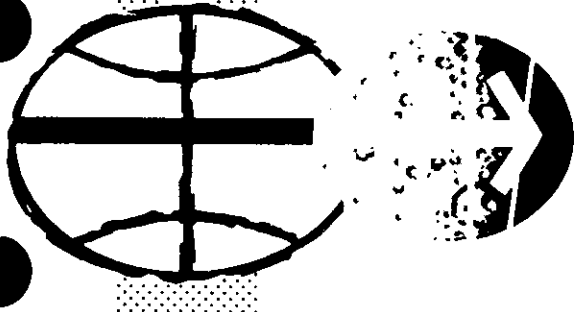
MSC INTERNAL NOTE NO. 70-FM-127

August 25, 1970

APOLLO 14
LANDING POINT DESIGNATOR
(LPD) ERROR ANALYSIS

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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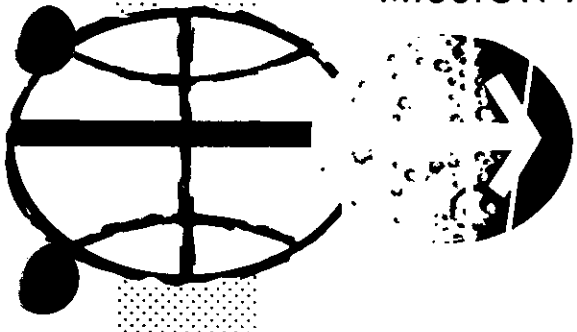
MSC INTERNAL NOTE NO. 70-FM-128

September 4, 1970

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 14 (MISSION H-3) LAUNCHED JANUARY 31, 1971 VOLUME II - TRAJECTORY PARAMETERS

Lunar Mission Analysis Branch,
Orbital Mission Analysis Branch,
and
Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE 70-FM-128 DATED SEPTEMBER 4, 1970

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 14

(MISSION H-3) LAUNCHED JANUARY 31, 1971

VOLUME II - TRAJECTORY PARAMETERS

By Landing Analysis Branch, Orbital Mission Analysis Branch,

and Lunar Mission Analysis Branch

Change 1

December 11, 1970

Floyd V. Bennett, Chief
Landing Analysis Branch

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

Ronald L. Berry, Chief
Lunar Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

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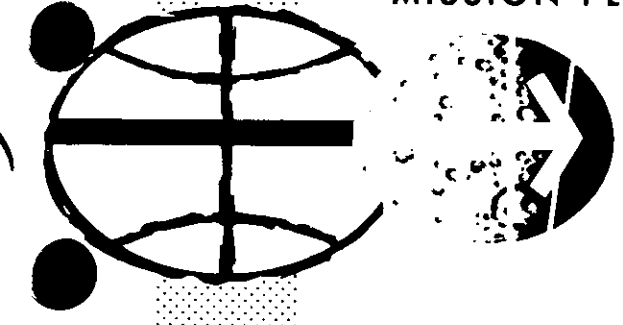
July 22, 1970

EFFECTS OF GROUNDTRACK CONTROL REQUIREMENTS ON THE DESIGN OF THE EARTH ORBIT SHUTTLE

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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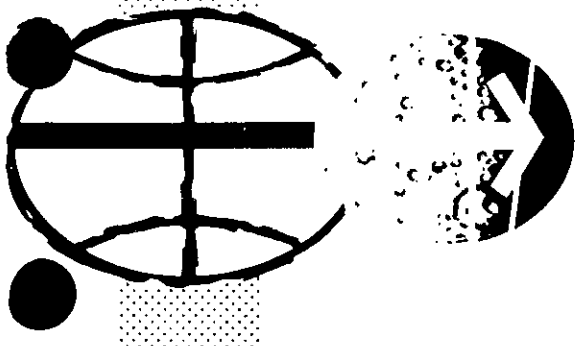
September 10, 1970

AN ANALYSIS OF THE APOLLO ENTRY MONITORING PLAN

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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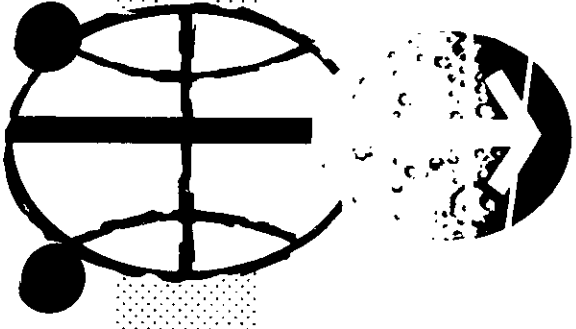
MSC INTERNAL NOTE NO. 70-FM-131

August 28, 1970

SHUTTLECRAFT LAUNCH PERFORMANCE AND ORBIT INSERTION ANALYSIS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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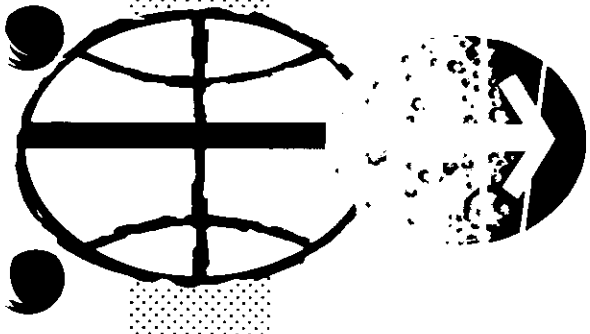
MSC INTERNAL NOTE NO. 70-FM-132

September 3, 1970

P23 ERROR MODEL AND PROCEDURES ANALYSIS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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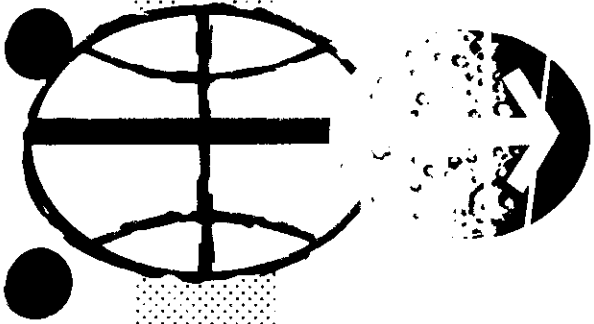
SEPTEMBER 22, 1970

COMPUTER USAGE PROGRAM

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 70-FM-134

September 14, 1970

LOGIC AND EQUATIONS FOR THE CALCULATION OF TRAJECTORY OPPORTUNITIES FOR A SPACECRAFT IN EARTH ORBIT

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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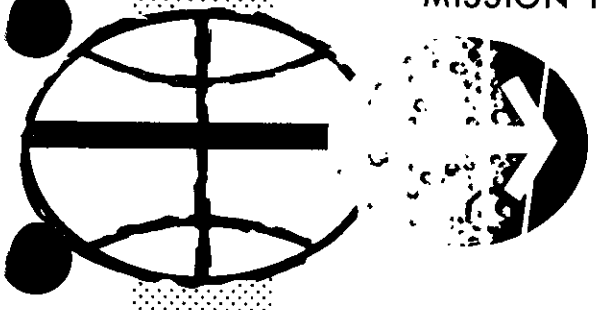
September 21, 1970

1981-1982 MARS ROUND-TRIP ORBITAL MISSIONS USING TWO-IMPULSE, THREE-IMPULSE, AND VENUS-SWINGBY TRAJECTORIES: RETURN TO ELLIPTICAL CAPTURE ORBIT AT EARTH

Advanced Mission Design Branch
MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 70-FM-137

September 10, 1970

EFFECTS OF VEHICLE ROTATION ON HEAT LEAK INTO CYLINDRICAL CRYOGENIC TANKS

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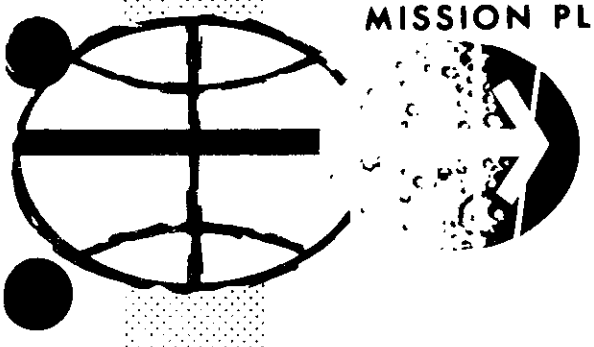
MISSION PLANNING AND ANALYSIS DIVISION



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September 30, 1970

SOME PRELIMINARY ASCENT TRAJECTORY AND BOOSTER FLYBACK CONSIDERATIONS FOR THE SPACE SHUTTLE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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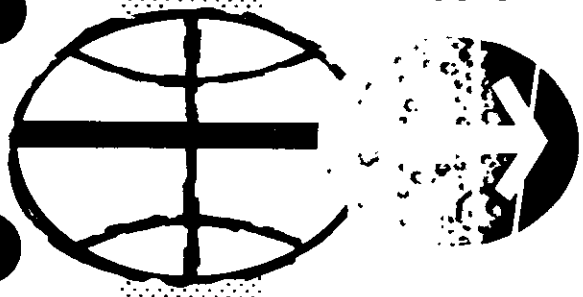
September 24, 1970

SKYLAB AM/OWS/MDA PARAMETRIC STUDY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-141

September 25, 1970

THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 14 (MISSION H-3) LAUNCHED JANUARY 31, 1971 VOLUME I - MISSION PROFILE

Lunar Mission Analysis Branch,
Orbital Mission Analysis Branch,
and
Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE 70-FM-141 DATED SEPTEMBER 25, 1970

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 14

(MISSION H-3) LAUNCHED JANUARY 31, 1971

VOLUME I - MISSION PROFILE

By Landing Analysis Branch, Orbital Mission Analysis Branch,

and Lunar Mission Analysis Branch

Change 1

December 11, 1970

Floyd V. Bennett, Chief
Landing Analysis Branch

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

Ronald L. Berry, Chief
Lunar Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

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REVISION 5

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-142

October 6, 1970

REVISION 5

RTCC REQUIREMENTS FOR APOLLO 14 (MISSION H-3): EARTH ORBIT INSERTION PROCESSOR

(This document supersedes MSC Internal Note No. 69-FM-286 dated November 24, 1969.)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 70-FM-143

September 23, 1970

PRELIMINARY SHUTTLE DYNAMICS ANALYSIS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

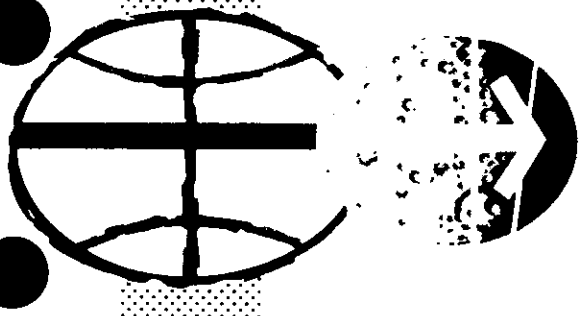
MSC INTERNAL NOTE NO. 70-FM-144

September 22, 1970

ORBIT ALTITUDE SELECTION FOR ASSEMBLY AND REFUELING DURING ADVANCED LUNAR AND PLANETARY MISSIONS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

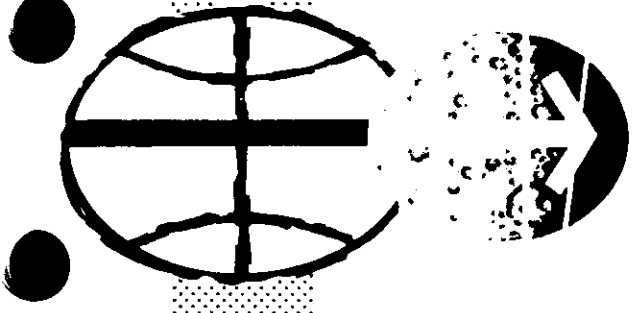
MSC INTERNAL NOTE NO. 70-FM-145

September 25, 1970

RTCC REQUIREMENTS FOR APOLLO 14 (MISSION H-3): LOI TARGETING REVISION 1

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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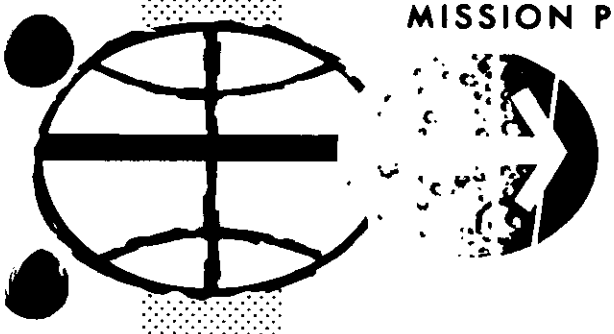
MSC INTERNAL NOTE NO. 70-FM-146

September 28, 1970

LANDING POINT DESIGNATOR ERROR ANALYSIS FOR POTENTIAL LANDING SITES (MARIUS HILLS, HADLEY, AND COPERNICUS)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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September 28, 1970

TYPICAL SHUTTLE MISSION PROFILES AND ATTITUDE TIME LINES VOLUME II - FOUR SCIENTIFIC SUPPORT MISSIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 70-FM-148

November 13, 1970

THE ACTIVITIES SCHEDULING PROGRAM ELECTRICAL POWER SUBSYSTEM FORMULATION REQUIREMENTS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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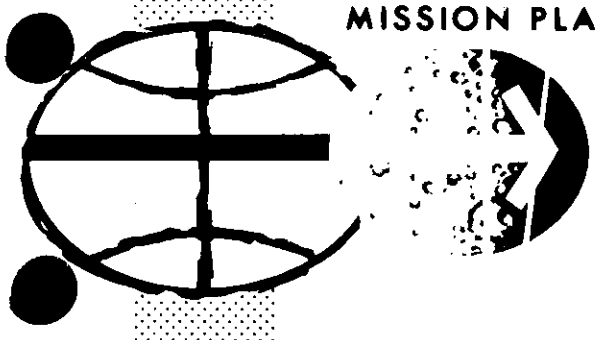
MSC INTERNAL NOTE NO. 70-FM-150

OCTOBER 7, 1970

APOLLO EXPERIENCE REPORT: APOLLO NAVIGATION SUPPORT TECHNIQUES AND PROBLEM AREAS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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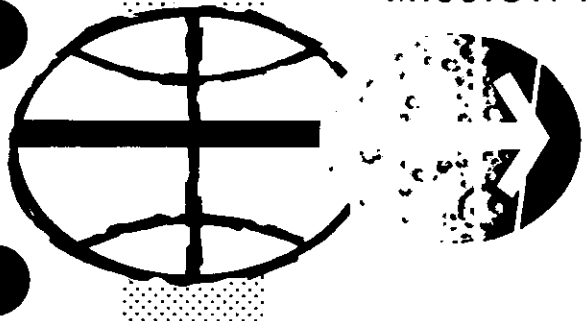
MSC INTERNAL NOTE NO. 70-FM-149

September 22, 1970

A COMPARISON OF THE APOLLO 13 AND APOLLO 14 DESCENT TRAJECTORIES

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 70-FM-151

October 13, 1970

SKYLAB PRELIMINARY REFERENCE TRAJECTORY

Orbital Mission Analysis Branch

and Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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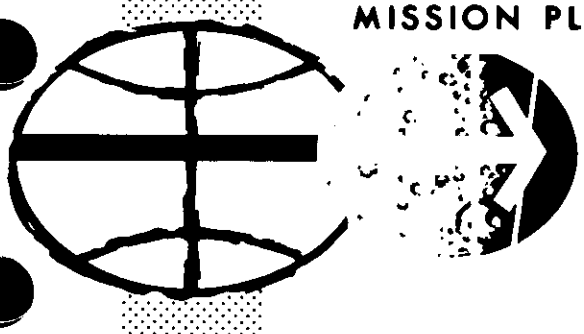
October 5, 1970

THE ACTIVITIES SCHEDULER ENVIRONMENTAL CONTROL SYSTEM MODEL

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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September 28, 1970

APOLLO EXPERIENCE REPORT: APOLLO SPACECRAFT AND GROUND SOFTWARE DEVELOPMENT FOR RENDEZVOUS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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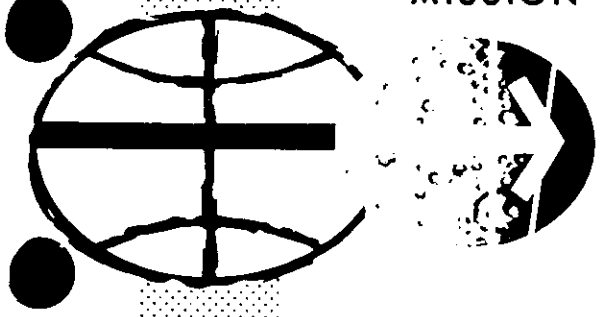
MSC INTERNAL NOTE NO. 70-FM-129

August 31, 1970

SUBSONIC PERFORMANCE CHARACTERISTICS OF THE DC-3 SHUTTLECRAFT BOOSTER AND ORBITER

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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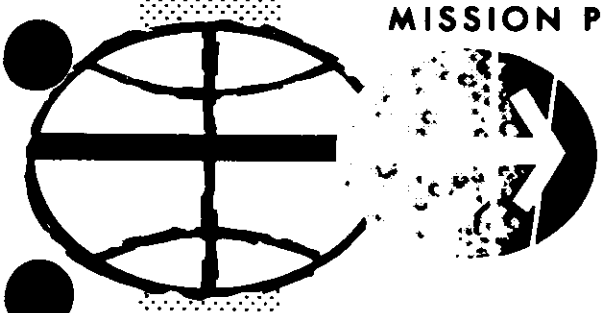
October 5, 1970

APOLLO EXPERIENCE REPORT: MISSION PLANNING FOR APOLLO REENTRY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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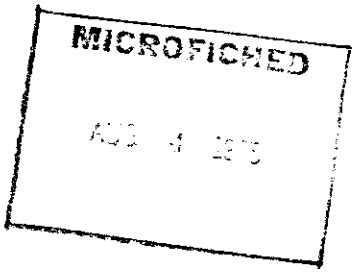
MSC INTERNAL NOTE NO. 70-FM-156

September 30, 1970

BEYOND APOLLO



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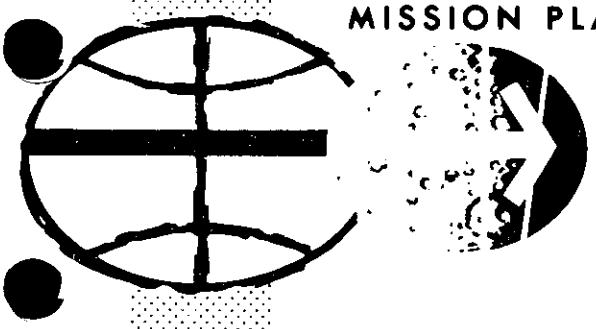
MISSION PLANNING AND ANALYSIS DIVISION



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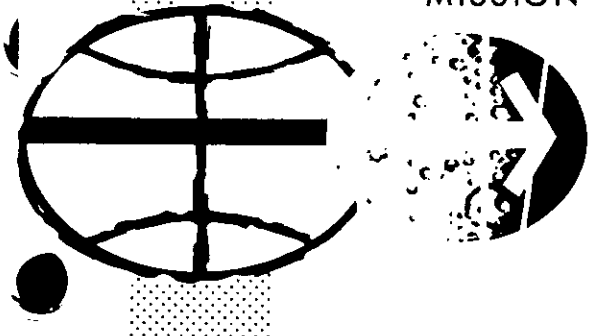
October 2, 1970

APOLLO 14 (MISSION H-3)

PRELIMINARY CREW CHARTS

Mission Planning Support Office
MISSION PLANNING AND ANALYSIS DIVISION



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October 7, 1970

PRELIMINARY ALTERNATIVES FOR REDUCING THE EARTH ORBITAL SHUTTLE RENDEZVOUS RESCUE TIME

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-160

November 10, 1970

PRELIMINARY PROGRAM DESCRIPTION AND FLOW DIAGRAM OF THE TACS-SM RCS CONSUMABLES PROGRAM

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-161

October 12, 1970

PROPELLANT WEIGHT REQUIREMENTS FOR THE 1986 CONJUNCTION CLASS MANNED MARS LANDING MISSION

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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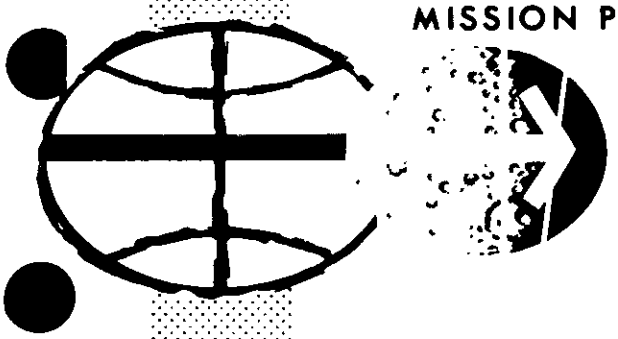
MSC INTERNAL NOTE NO. 70-FM-162

November 4, 1970

A PRELIMINARY DESCRIPTION OF THE TAPE RECORDER MANAGEMENT MODULE FOR THE MISSION OPERATIONS PLANNING SYSTEM

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

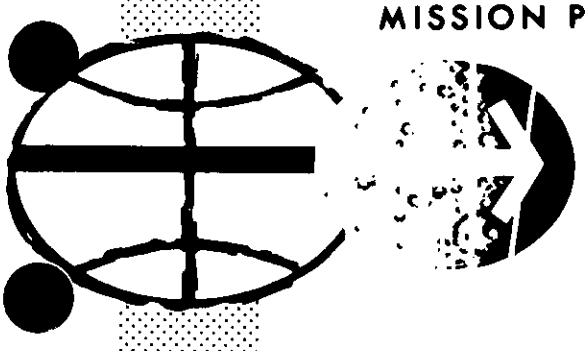
MSC INTERNAL NOTE NO. 70-FM-163

October 8, 1970

PRELIMINARY REFERENCE TRAJECTORY SIMULATOR DATA PACKAGE FOR SKYLAB 1/2

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

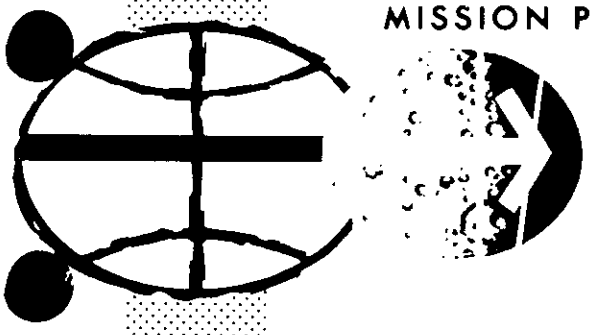
MSC INTERNAL NOTE NO. 70-FM-164

October 12, 1970

PRELIMINARY CONSUMABLES ANALYSIS FOR THE APOLLO 15 (J-1) MISSION

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

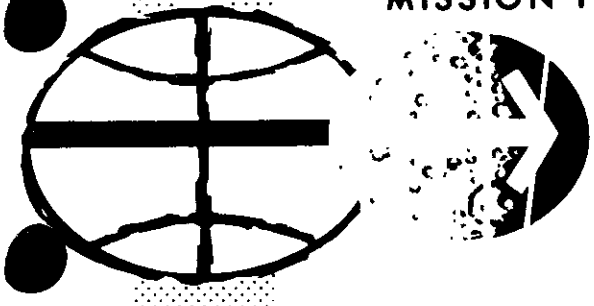
MSC INTERNAL NOTE NO. 70-FM-165

October 14, 1970

PRELIMINARY SHUTTLE ABORT STUDIES

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-03441

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-166

October 29, 1970

LOGIC FOR EARTH ORBITAL AEG WITH JACCHIA DYNAMIC ATMOSPHERES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-166 DATED OCTOBER 29, 1970

LOGIC FOR EARTH ORBITAL AEG WITH JACCHIA DYNAMIC ATMOSPHERE

By Edward J. Kenyon

Change 1

February 2, 1971

R. R. Regelbrugge, Assistant Chief
Program Development Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacement pages, have been inserted, insert this CHANGE SHEET between the cover and the title page and write on the cover, "CHANGE 1 inserted."

1. Replace pages iii, 6, 7, 8, 11, 17, 19, 24, 25, 26, 27, and 33
2. Delete pages 38 to 50
3. Add new page 38 and 39
4. The new reference page will be numbered 40

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 70-FM-166 (MSC-03441) DATED OCTOBER 29, 1970

LOGIC FOR EARTH ORBITAL AEG WITH

JACCHIA DYNAMIC ATMOSPHERE

By William A. Reini

Change 2

May 1, 1972

for R. R. Regelbrugge, Chief
Software Development Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

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1. Replace pages 6, 7, 10, 11, 12, 18, 23, 24, 25, 26, 27, 29, 30, 31, 32, 33, 34, 35, 36, 37, and 40

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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

REPLY TO ATTN OF: 71-FM93-07

FEB 2 1971

MEMORANDUM TO: See list below

FROM : FM9/Program Development Branch

SUBJECT : Transmittal of detailed requirements for the Skylab Analytic Ephemeris Generator (AEG)

The enclosure constitutes Change 1 to MSC Internal Note 70-FM-166 which presents detailed requirements for the Analytic Ephemeris Generator (AEG) to be employed in support of the Skylab mission. This change will allow the AEG to use the same Jacchia density model as the one used by the RTCC integrator as defined in MSC Internal Note 70-FM-202. In addition, this change presents minor additions and corrections to the present program logic of the AEG.

Robert R. Regelbrugge

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

The Flight Software Branch concurs with the above recommendations.

Larry J. Dungan for
James C. Stokes, Jr.
Chief, Flight Software Branch

Enclosure

Addressees: (See attached list)

FM9:EJKenyon:rmr

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

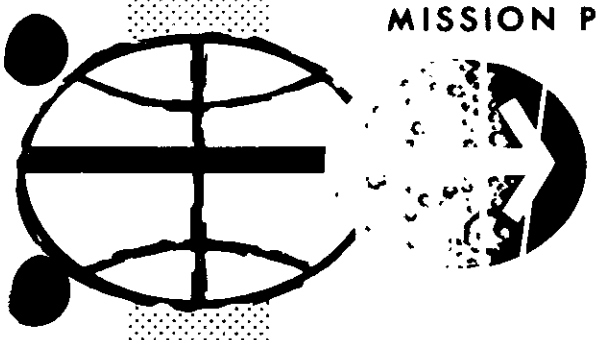
MSC INTERNAL NOTE NO. 70-FM-167

October 22, 1970

THE CONSUMABLES ANALYSIS FOR THE APOLLO 14 (MISSION H-3) SPACECRAFT OPERATIONAL TRAJECTORY; JANUARY 31, 1971 LAUNCH DATE

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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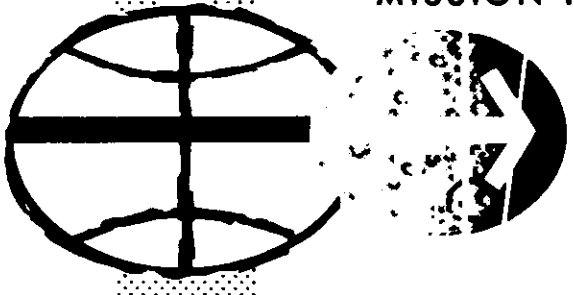
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-168

October 20, 1970

COLLISION PROBABILITY OF FUTURE MANNED MISSIONS WITH OBJECTS IN EARTH ORBIT

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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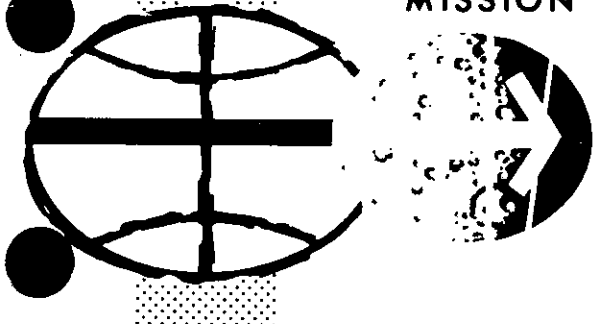
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-169

October 21, 1970

ABORT RESET POINTS FOR APOLLO 14

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-170

October 22, 1970

APOLLO EXPERIENCE REPORT: MISSION PLANNING FOR LUNAR DESCENT AND ASCENT

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

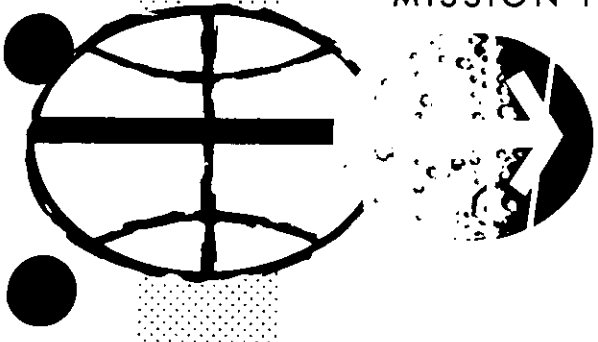
MSC INTERNAL NOTE NO. 70-FM-171

November 6, 1970

APOLLO EXPERIENCE REPORT: ONBOARD NAVIGATION AND ALINEMENT SOFTWARE

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

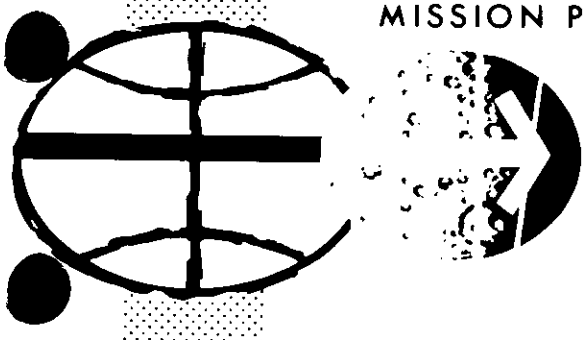
MSC INTERNAL NOTE NO. 70-FM-172

December 9, 1970

APOLLO EXPERIENCE REPORT: CONSUMABLES BUDGETING FOR THE APOLLO SPACECRAFT

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

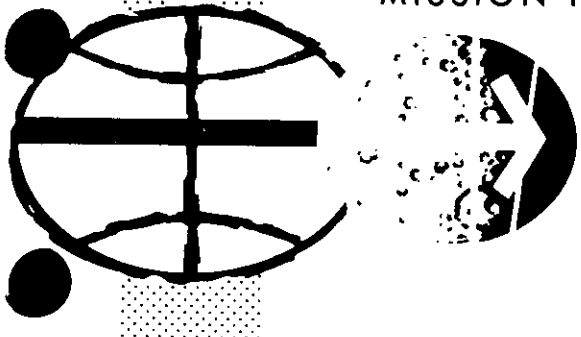
MSC INTERNAL NOTE NO. 70-FM-173

November 13, 1970

PRELIMINARY EVALUATION OF THE COMPATIBILITY OF POTENTIAL PAYLOADS WITH CANDIDATE EARTH ORBIT SHUTTLE CONFIGURATIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 174

October 27, 1970

RECOMMENDED ENTRY MONITORING AND BACKUP CONTROL PROCEDURES FOR APOLLO 14 (MISSION H-3)

LANDING ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

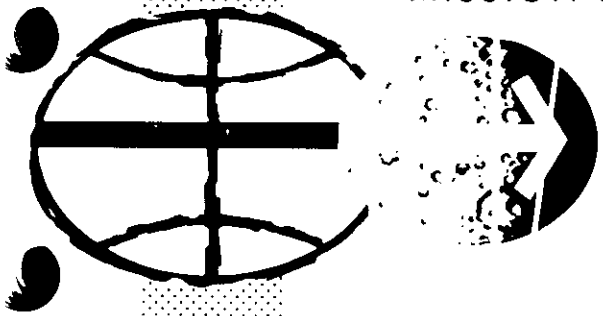
MSC INTERNAL NOTE NO. 70-FM-175

November 4, 1970

AUTOMATIC LANDING SYSTEMS AND NAVIGATION AIDS FOR APPLICATION TO THE SPACE SHUTTLE

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-176

November 2, 1970

AERODYNAMIC LOAD RELIEF USING ANGLE OF ATTACK MODULATION FOR ABORTS FROM THE SHUTTLE ORBITER VEHICLE LAUNCH TRAJECTORY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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REVISION 6

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-177

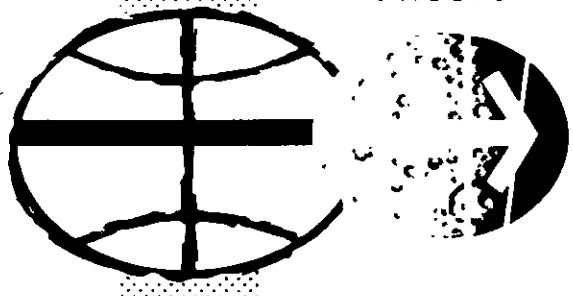
November 9, 1970

REVISION 6
RTCC REQUIREMENTS FOR
APOLLO 14 (MISSION H-3):
EARTH ORBIT INSERTION PROCESSOR

(This document supersedes MSC Internal Note No. 70-FM-142 dated October 6, 1970)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

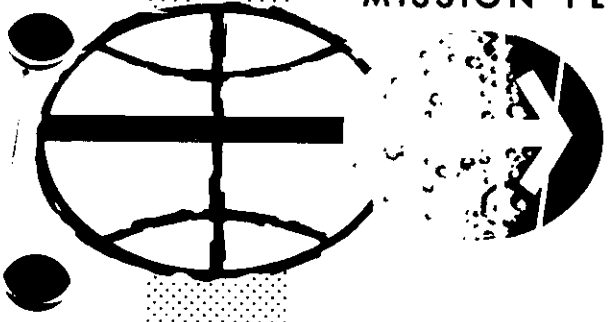
MSC INTERNAL NOTE NO. 70-FM-154

November 2, 1970

APOLLO EXPERIENCE REPORT: LUNAR ORBIT RENDEZVOUS DEVELOPMENT FOR APOLLO

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

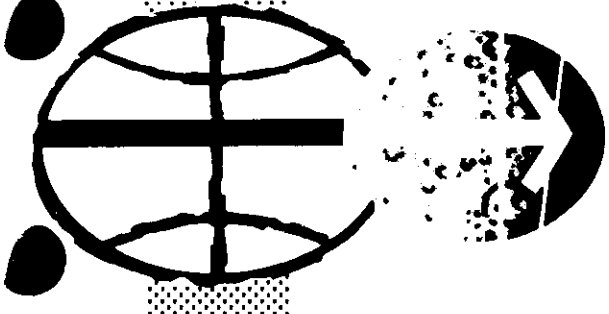
MSC INTERNAL NOTE NO. 70-FM-180

November 12, 1970

SPECIFICATIONS FOR THE ACTIVITY ELEMENT OPTIONS OF THE ACTIVITY SCHEDULING PROGRAM

Program Development Branch

MISSION PLANNING AND ANALYSIS DIVISION



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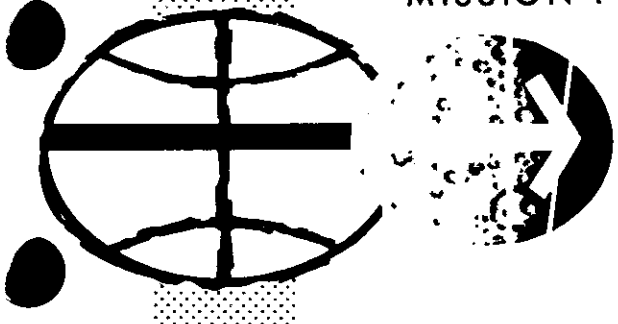
MSC INTERNAL NOTE NO. 70-FM-181

November 12, 1970

LAUNCH WINDOW SCANS AND ASSOCIATED MISSION PLANNING DATA FOR 1972

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

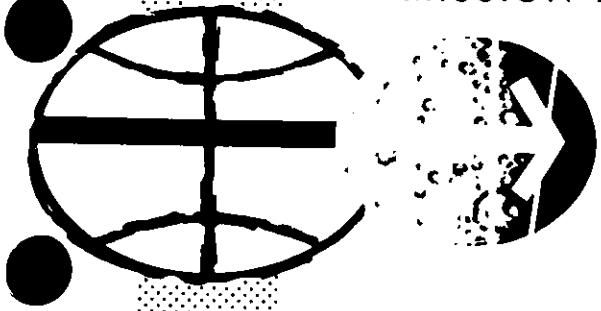
MSC INTERNAL NOTE NO. 70-FM-182

November 12, 1970

VIKING '75 ENTRY CORRIDOR DEFINITION FOR OPTION B

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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Volume II

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-183

December 9, 1970

OPERATIONAL ABORT PLAN FOR APOLLO 14 (MISSION H-3) VOLUME II - TRANSLUNAR, LUNAR ORBIT, AND TRANSEARTH ABORTS

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-03621

Addendum

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-183

January 22, 1971

ADDENDUM TO THE OPERATIONAL ABORT PLAN FOR APOLLO 14 (MISSION H-3) VOLUME II - TRANSLUNAR, LUNAR ORBIT, AND TRANSEARTH ABORTS

Planetary Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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FOR

MSC INTERNAL NOTE 70-FM-183 DATED DECEMBER 9, 1970

OPERATIONAL ABORT PLAN FOR APOLLO 14 (MISSION H-3)

VOLUME II - TRANSLUNAR, LUNAR ORBIT, AND TRANSEARTH ABORTS

By Lazarus Gonzales, Jr.

Change 1

January 15, 1971

Ronald L. Berry, Chief
Planetary Mission Analysis
Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

Page 1 of __
(with enclosures)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-184

November 17, 1970

OPERATIONAL LOGISTICS PLANNING

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-185

December 8, 1970

A PRELIMINARY DESCRIPTION OF THE PHOTOGRAPHIC RESOURCES MANAGEMENT MODULE (PRMM) FOR THE MISSION OPERATIONS PLANNING SYSTEM

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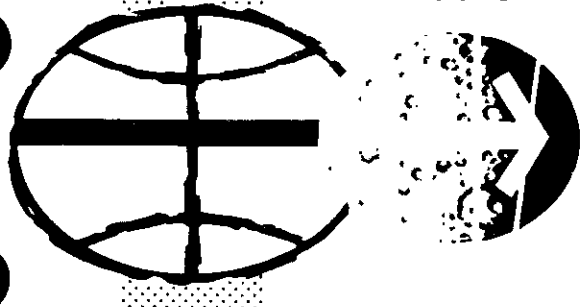
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

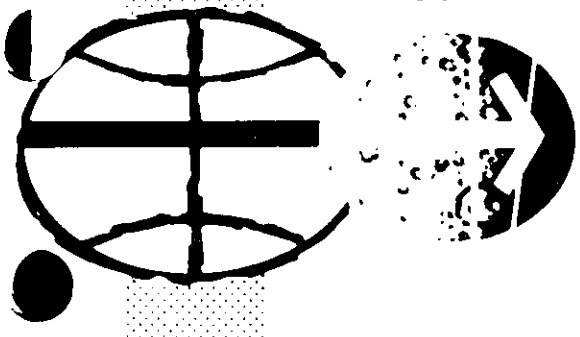
MSC INTERNAL NOTE NO. 70-FM-186

November 24, 1970

SKYLAB ATTITUDE SEQUENCE DOCUMENT DEFINITION

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-187

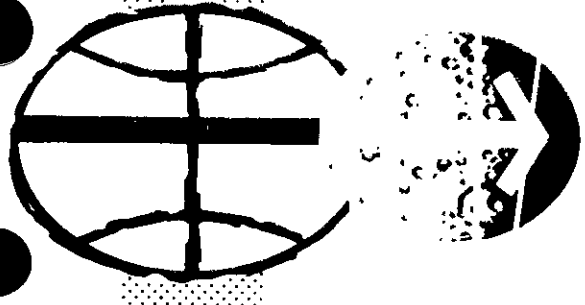
November 24, 1970

MPAD SOFTWARE DEVELOPMENT PLAN: MISSION OPERATIONS PLANNING SYSTEM (MOPS)

(This document supersedes MSC Internal Note NO. 70-FM-136 dated September 8, 1970.)

Program Development Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-188

November 24, 1970

VIEWS FROM THE SPACECRAFT DURING THE FLIGHT OF APOLLO 14, LAUNCHED JANUARY 31, 1971

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

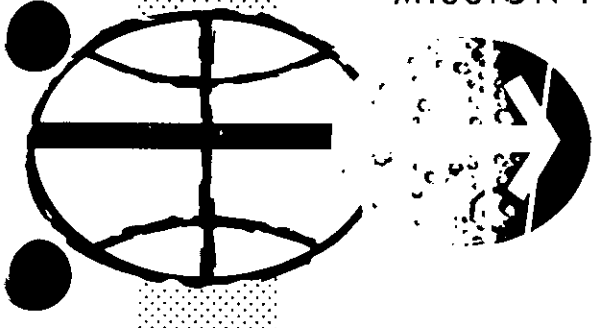
MSC INTERNAL NOTE NO. 70-FM-189

November 24, 1970

PRELIMINARY LUNAR ORBIT ATTITUDE SEQUENCE FOR APOLLO 14 (MISSION H-3)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-190

November 25, 1970

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1975 DIRECT ENTRY VIKING MISSION PERFORMANCE ANALYSIS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-179

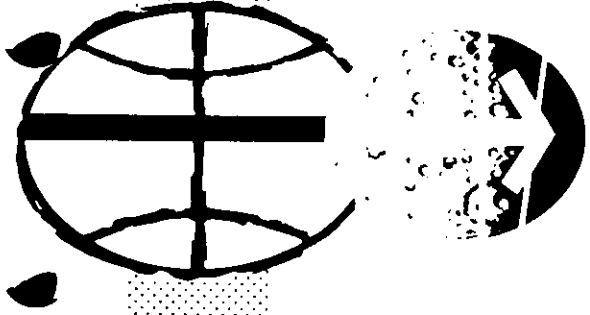
November 9, 1970

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 14 (MISSION H-3) LAUNCHED MARCH 1, 1971

VOLUME II - TRAJECTORY PARAMETERS

Landing Analysis Branch,
Orbital Mission Analysis Branch,
and
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Houston, Texas 77058

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REPLY TO
ATTN OF: 70-FM37-183

DEC 15 1970

MEMORANDUM TO: Informal Distribution

FROM : FM3/Flight Analysis Branch

SUBJECT : Additional data on Apollo 15 SIM door relative motion for jettison in lunar orbit

Reference: Internal Note 70-FM-191 by M. L. Williamson (FA5) and Dell Davidson (TRW Systems Group), "SIM Bay Door Jettison Relative Motion Analysis for Apollo 14 and Subsequent Missions," dated December 2, 1970.

In the above referenced, the effects of jettisoning the SIM door in lunar orbit after DOI at 7.3 to 10.9 fps were discussed with respect to relative motion. It was stated that at the time of nominal ascent (75 hours after jettison), the SIM door would be approximately 3000 miles ahead of the CSM. No information on relative motion subsequent to this time was presented, however.

Until the SIM door laps or phases with the CSM/LM in the 60 n. mi. circular lunar orbit, no recontact problems are present. For a jettison in the 60 X 8 n. mi. descent orbit, this will not occur until approximately 140 - 170 hours after jettison or 64 - 94 hours after docking. Therefore, at the end of a post docking lunar stay time of two days, the CSM would be approximately 640 - 2070 miles ahead of the SIM door.

Should the CSM remain in the descent orbit (60 X 8 n. mi.), lapping would not occur until 360 - 500 hours after jettison. If the SIM door were jettisoned in a 60 n. mi. circular orbit and the CSM remained in that orbit, lapping would not occur until approximately 340 to 520 hours after jettison.

Additional SIM door relative motion analyses will be performed, if necessary, when lunar orbit timelines are finalized. No recontact problems exist with currently proposed procedures, and none are anticipated when timelines are finalized.

Marland L. Williamson

Marland L. Williamson

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

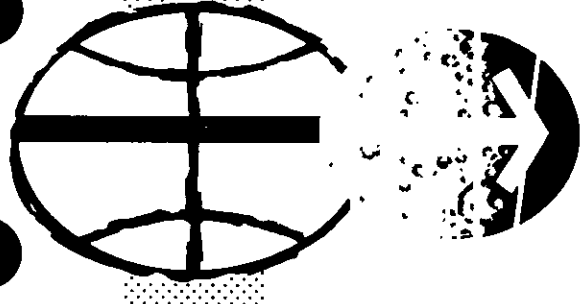
MSC INTERNAL NOTE NO. 70-FM-192

December 14, 1970

FROM TOYS TO SPACE STATIONS AN ANALYSIS OF THE ROTATIONAL MOTION OF AN ARTICULATED, ZERO ANGULAR MOMENTUM SPACE STATION CONFIGURATION

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

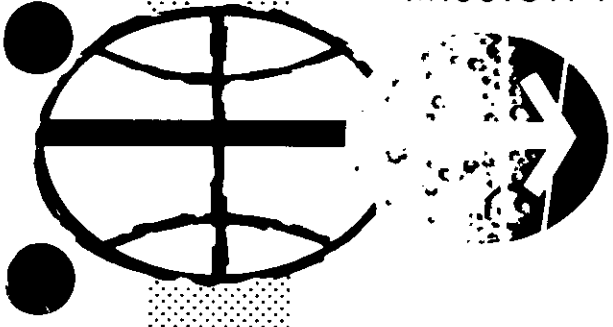
MSC INTERNAL NOTE NO. 70-FM-193

December 15, 1970

CHARACTERISTICS OF THE LIFTING BODY ORBITER STAGE OF AN EARTH-ORBITAL SHUTTLE FOR AN UNPOWERED LANDING

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-03621
Volume I

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

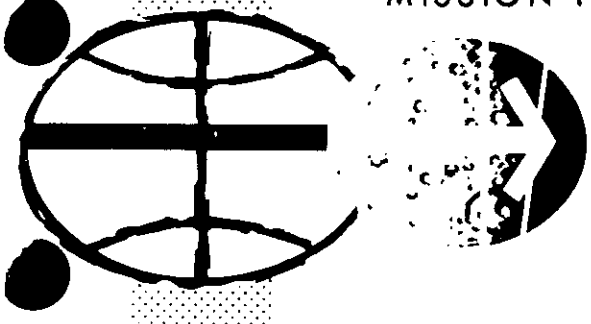
INTERNAL NOTE NO. 70-FM-194

December 15, 1970

OPERATIONAL ABORT PLAN FOR APOLLO 14 (MISSION H-3) VOLUME I - LAUNCH PHASE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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Volume III

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-195

December 11, 1970

TYPICAL SHUTTLE MISSION PROFILES AND ATTITUDE TIME LINES VOLUME III- FIRST 10 SHUTTLE MISSIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-196

December 18, 1970

SOME PRELIMINARY SHUTTLE LAUNCH TRAJECTORIES TO VARIOUS INCLINATIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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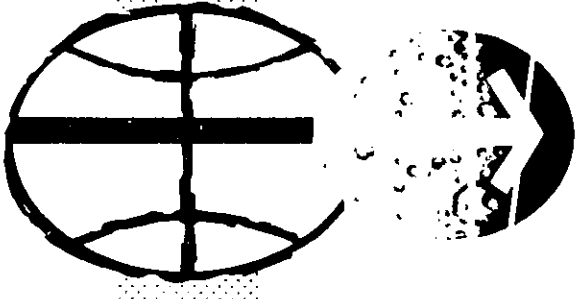

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-197

December 11, 1970

APOLLO EXPERIENCE REPORT: APOLLO REAL-TIME OFF-LINE COMPUTATIONAL FACILITY DEVELOPMENT AND EXPERIENCE

Program Development Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

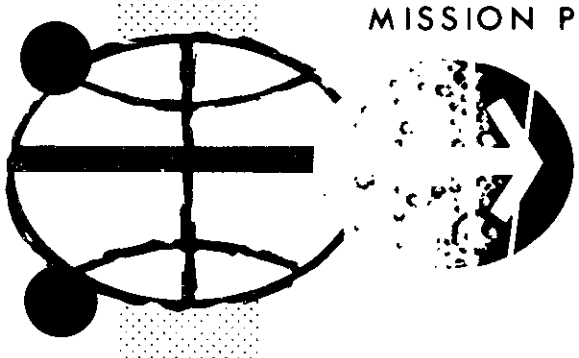
MSC INTERNAL NOTE NO. 70-FM-198

December 22, 1970

SKYLAB LAUNCH WINDOW PROCESSOR

Program Development Branch

MISSION PLANNING AND ANALYSIS DIVISION



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FOR

MSC INTERNAL NOTE 70-FM-198 (MSC-03763) DATED DECEMBER 22, 1970

SKYLAB LAUNCH WINDOW PROCESSOR

By Jerome W. Kahanek

Change 1

August 15, 1972

Elric N. McHenry, Acting Chief
Software Development Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-199

January 13, 1971

EFFECTS OF CLUSTER LEAKAGE RATES ON THE SKYLAB M509 EXPERIMENT

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

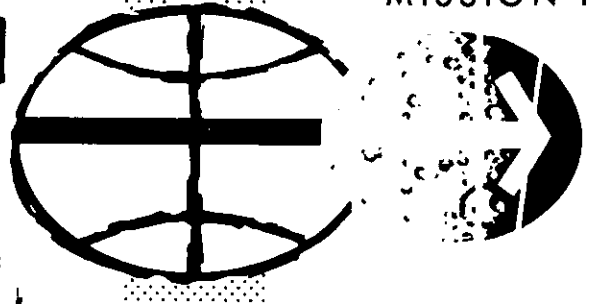
MSC INTERNAL NOTE NO. 70-FM-200

December 24, 1970

RTCC REQUIREMENTS FOR APOLLO 14: TRAJECTORY PREDICTION PROGRAM DESCRIPTION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-201

December 15, 1970

STEEP DESCENT TRAJECTORY CONSIDERATIONS FOR APOLLO 15

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-202

January 26, 1971

RTCC AND MOPS REQUIREMENTS FOR: MODIFIED 1970 JACCHIA ATMOSPHERE MODEL

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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FOR

MSC INTERNAL NOTE 70-FM-202 DATED JANUARY 26, 1971

RTCC AND MOPS REQUIREMENTS FOR:

MODIFIED 1970 JACCHIA ATMOSPHERE MODEL

By J. R. Lewis and R. B. Sabayrec, TRW Systems Group,
G. A. Austin, Analytical Mechanics Associates, and
B. F. Cockrell, Mathematical Physics Branch

Change 1

April 19, 1971

James C. McPherson, Chief
Mathematical Physics Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

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Replace pages 9 and 10 with corrected pages.

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DISCLOSURE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

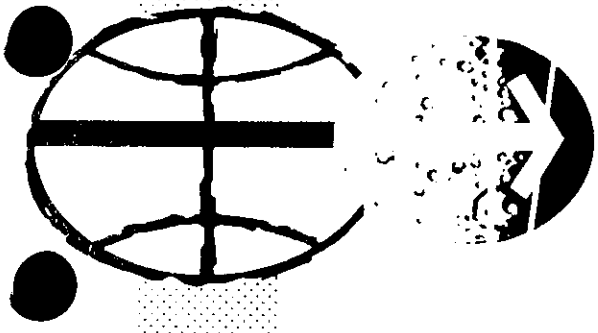
MSC INTERNAL NOTE NO. 70-FM-205

December 16, 1970

A PRELIMINARY APOLLO 15 POWERED DESCENT TRAJECTORY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

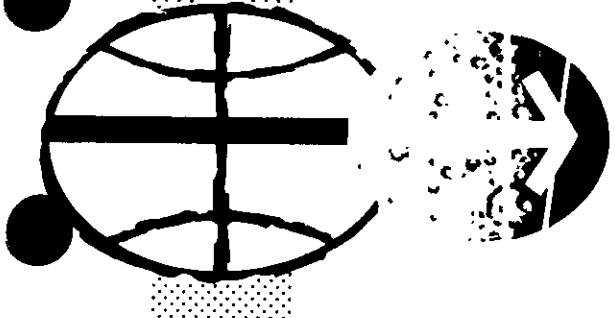
MSC INTERNAL NOTE NO. 70-FM-206

December 21, 1970

APOLLO 14 S-IVB POST-TLI TRACKING ACCURACIES

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

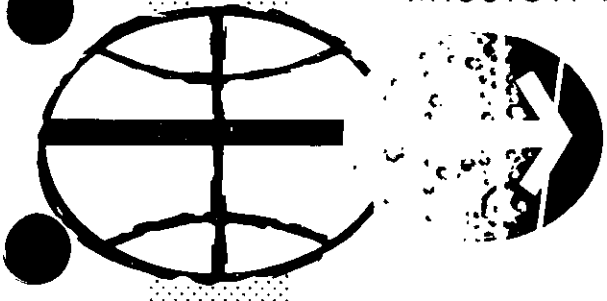
MSC INTERNAL NOTE NO. 70-FM-207

December 29, 1970

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 14 (MISSION H-3)

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

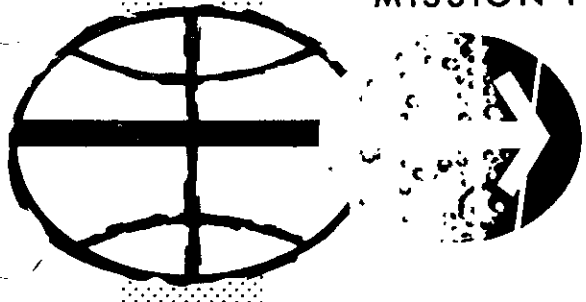
MSC INTERNAL NOTE NO. 70-FM-208

December 21, 1970

APOLLO 14 (MISSION H-3)
FINAL CREW CHARTS

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

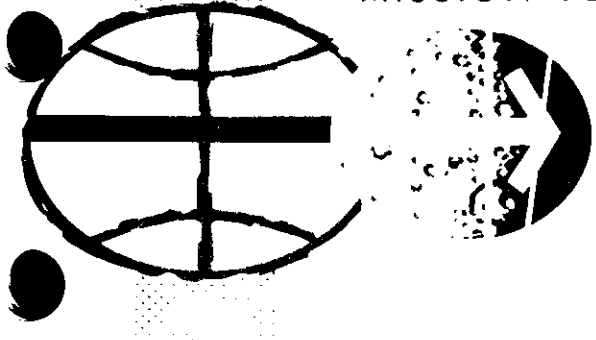
MSC INTERNAL NOTE NO. 70-FM-209

January 5, 1971

PRELIMINARY MISSION PROFILE FOR THE DESCENT AND LANDING OF THE SHUTTLECRAFT

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

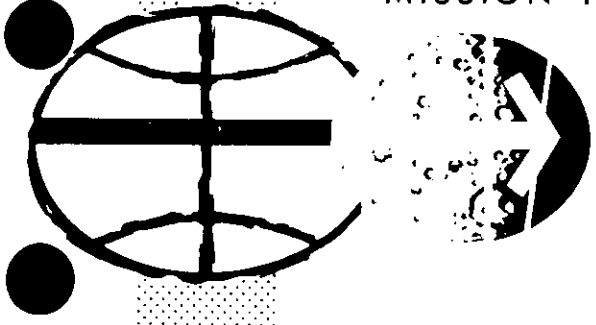
MSC INTERNAL NOTE NO. 70-FM-210

January 4, 1971

SHUTTLE NAVIGATION SENSOR REQUIREMENTS VOLUME I- ONBOARD RENDEZVOUS SENSORS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

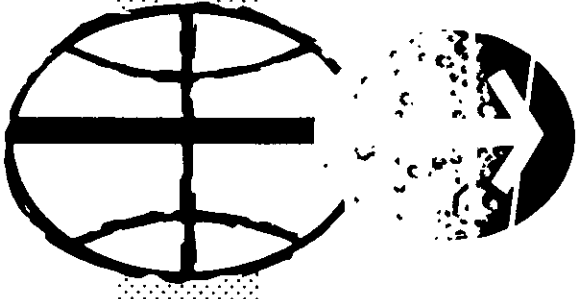
MSC INTERNAL NOTE NO. 70-FM-211

December 29, 1970

SPECIFICATIONS FOR THE CREW MODEL OF THE ACTIVITY SCHEDULING PROGRAM

Program Development Branch

MISSION PLANNING AND ANALYSIS DIVISION



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FOR

MSC INTERNAL NOTE NO. 70-FM-211

SPECIFICATIONS FOR THE CREW MODEL OF

THE ACTIVITY SCHEDULING PROGRAM

By F. W. Knopf and R. L. Petty

Change 1

June 8, 1971

APPROVED: Robert R. Regelbrugge
Robert R. Regelbrugge, Assistant Chief
Program Development Branch

APPROVED:
John P. Mayer, Chief
Mission Planning and Analysis Division

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Mission Planning and Analysis Division
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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REPLY TO ATTN OF: FM9 (71-89)

JUL 8 1971

MEMORANDUM

TO: See List Below

FROM: FM9/Chief, Program Development Branch

SUBJECT: Correction to Cover Memorandum Attached to Change 1 of the MSC Internal Note 70-FM-211

The cover memorandum attached to change 1 of MSC Internal Note 70-FM-211 was published with an incomplete signature page. The enclosure to this memorandum should be attached to the document instead of the previously published copy.

Robert R. Regelbrugge
Robert R. Regelbrugge

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APPROVED BY:

Carl R Huss
for John P. Mayer
Chief, Mission Planning
and Analysis Division

Enclosure

Addressees: (see attached list)

FM9:ENMcHenry:ccr:7-7-71

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CHANGE SHEET

FOR

MSC INTERNAL NOTE NO. 70-FM-211

(MSC-03792)

SPECIFICATIONS FOR THE CREW MODEL OF

THE ACTIVITY SCHEDULING PROGRAM

By F. W. Knopf

Change 2

November 8, 1971

APPROVED: Robert R. Regelbrugge

Robert R. Regelbrugge, Chief
Program Development Branch

APPROVED: Carl R. Huss
for

John P. Mayer, Chief
Mission Planning and Analysis Division

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-212

December 31, 1970

COMMANDER'S OUT-THE-WINDOW VISIBILITY DURING APOLLO 14 (MISSION H-3) LUNAR DESCENT

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

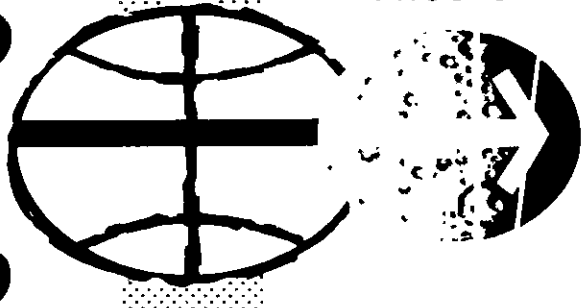
MSC INTERNAL NOTE NO. 70-FM-213

January 25, 1971

RTCC SKYLAB REQUIREMENTS: ONBOARD NAVIGATION/TIMING AND COORDINATE TRANSFORMATION DETERMINATION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-191

December 2, 1970

SIM BAY DOOR JETTISON RELATIVE MOTION ANALYSIS FOR APOLLO 15 AND SUBSEQUENT MISSIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-215

January 7, 1971

APOLLO 14 (MISSION H-3) SPACECRAFT DISPERSION ANALYSIS SUMMARY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

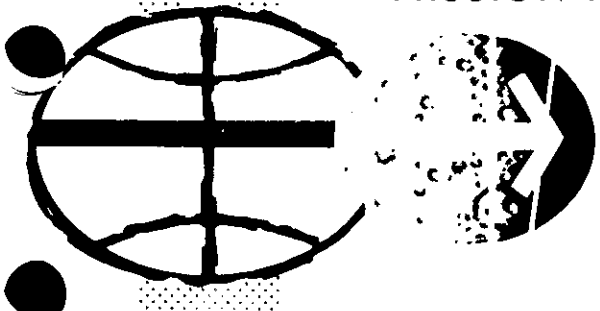
MSC INTERNAL NOTE NO. 70-FM-216

January 5, 1971

APOLLO 14 TLI GO/NO GO FOR A LUNAR LANDING - ALTERNATE MISSION

Planetary Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

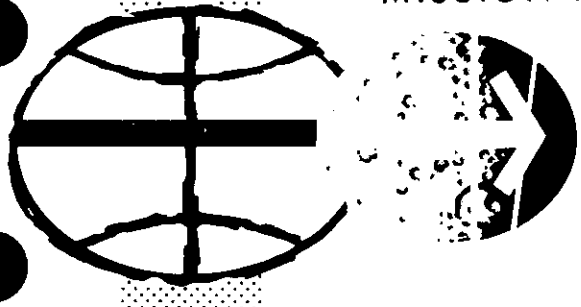
MSC INTERNAL NOTE NO. 70-FM-217

January 12, 1971

THE FINAL CONSUMABLES ANALYSIS FOR THE APOLLO 14 (H-3) SPACECRAFT OPERATIONAL TRAJECTORY; JANUARY 31, 1971, LAUNCH DATE

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE 70-FM-217 DATED JANUARY 12, 1971

THE FINAL CONSUMABLES ANALYSIS FOR THE APOLLO 14 (H-3)

SPACECRAFT OPERATIONAL TRAJECTORY; JANUARY 31, 1971, LAUNCH DATE

By P. F. Cantin, V. S. Ritchey, R. M. Swalin,
and S. A. Kamen

Change 1

January 21, 1971

Marlowe D. Cassetti, Chief
Guidance and Performance Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

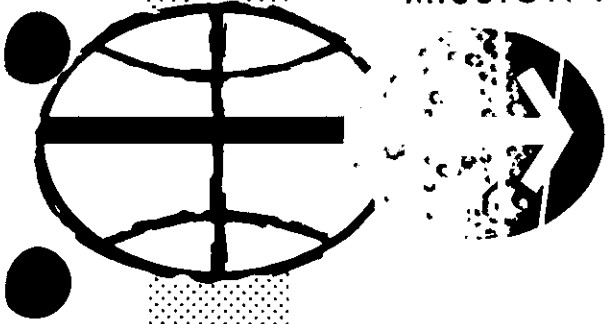
MSC INTERNAL NOTE NO. 70-FM-218

January 5, 1971

A DESCRIPTION OF THE APOLLO 14 POWERED DESCENT TRAJECTORY AND DESCENT MONITORING TECHNIQUES

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-03857

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-219

January 15, 1971

APOLLO G&N CONTINGENCY ALINEMENT ACCURACY UPDATE, AGS GRAVITY ALINEMENT AND RTCC LM IMU ORIENTATION DETERMINATION ACCURACY

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-03859

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

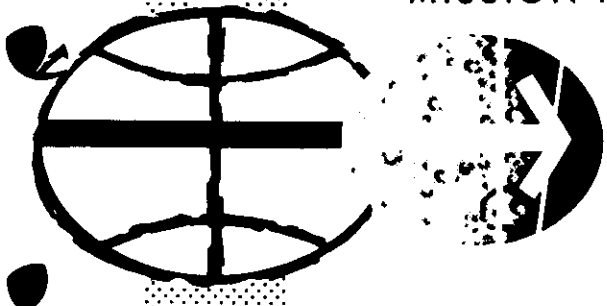
MSC INTERNAL NOTE NO. 70-FM-220

January 5, 1971

APOLLO 14 P-23 SIGHTING SCHEDULES FOR TRANSLUNAR HORIZON VERIFICATION AND TRANSEARTH CONSTRAINT TESTING, JANUARY 31, 1971, LAUNCH

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC-03861

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

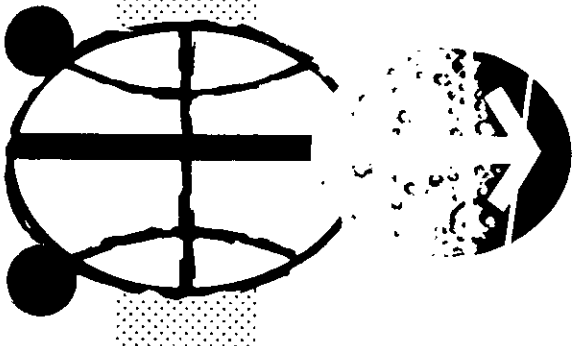
MSC INTERNAL NOTE NO. 70-FM-222

January 26, 1971

SKYLAB EPHEMERIS AND TRANSFORMATION REQUIREMENTS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-221

January 5, 1971

SKYLAB LOCAL VERTICAL ERRORS DUE TO ELLIPTICITY AND ASCENDING NODE PRECESSION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 70-FM-223

January 13, 1971

EARTH ORBIT-TO-ORBIT TUG CONFIGURATION

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

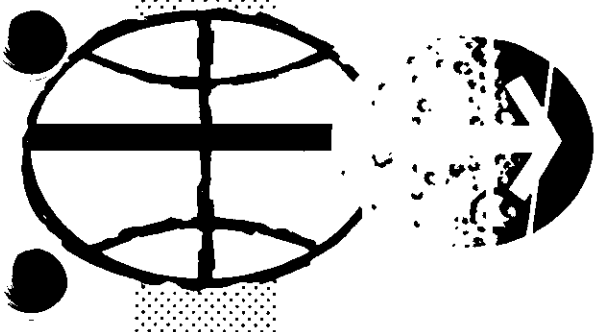
MSC INTERNAL NOTE NO. 70-FM-224

January 26, 1971

RTCC REQUIREMENTS FOR ANALYTIC DETERMINATION OF COORDINATE TRANSFORMATIONS FOR THE EARTH AND MOON FOR SKYLAB

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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CHANGE SHE

FOR

MSC INTERNAL NOTE 70-FM-224 DATED JANUARY 26, 1971

RTCC REQUIREMENTS FOR ANALYTIC DETERMINATION OF COORDINATE TRANSFORMATIONS FOR THE EARTH AND MOON FOR SKYLAB

By Howard G. deVezin, Mathematical Physics Branch
and Jim Dashiell, TRW Systems Group

Change 1

April 16, 1971

James C. McPherson, Chief
Mathematical Physics Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black bar in the margin indicates the area of change.

After the attached enclosures, which are replacements, have been inserted, insert this CHANGE SHEET between the cover and title page and write on the cover, "CHANGE 1 inserted."

1. Replace pages 1-2, 5-6, 19-20, 41-42, 43-44, 45-46, 49-50.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

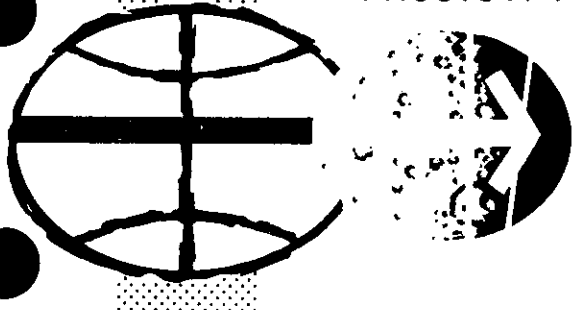
MSC INTERNAL NOTE NO. 71-FM-1

January 7, 1971

A FAMILY OF ROUND TRIP SATURN FLYBY TRAJECTORIES THAT ENCOUNTER JUPITER

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

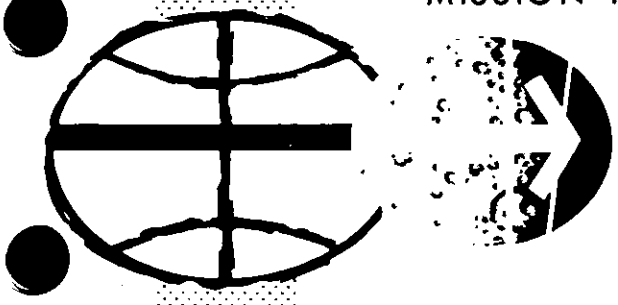
MSC INTERNAL NOTE NO. 71-FM-2

January 19, 1971

APOLLO 14 LUNAR LANDMARK LOCATIONS AND OFFSETS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-3

January 7, 1971

OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR APOLLO 14 (MISSION H-3)

Planetary Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-03870

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-4

January 13, 1971

OPTIMAL BOOST TRAJECTORIES FOR THE SHUTTLE VEHICLE

Program Development Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-5

January 15, 1971

ESTIMATED DE19 LUNAR EPHEMERIS ERRORS FOR THE APOLLO 14 MISSION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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Volume I

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-6

January 19, 1971

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 14 (MISSION H-3) LAUNCHED MARCH 1, 1971 VOLUME I - HYBRID MISSION PROFILE

Planetary Mission Analysis Branch,
Landing Analysis Branch,
and
Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-7

January 12, 1971

INFORMATION FOR INITIAL PLANNING OF MARS ASCENT RENDEZVOUS OF A SINGLE MARS LANDER WITH THE MISSION MODULE

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

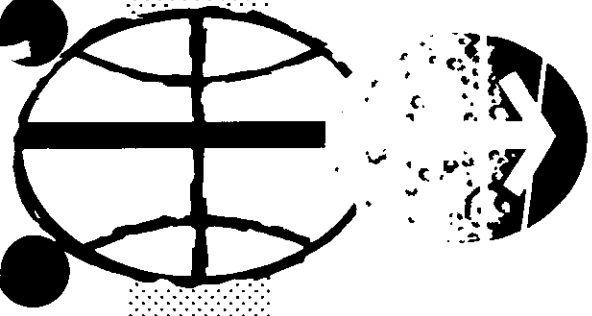
MSC INTERNAL NOTE NO. 71-FM-8

January 11, 1971

DESCRIPTION OF APOLLO 14 POWERED ASCENT TRAJECTORY AND DISPERSION ANALYSIS

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-9

January 15, 1971

VERIFICATION OF LUMINARY 178 RENDEZVOUS NAVIGATION PROGRAM (P-20)

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-10

January 20, 1971

APOLLO 14 S-IVB IMPACT TARGETING

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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[illegible]

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-11

January 15, 1971

VERIFICATION OF COMANCHE 108 P22 FOR APOLLO 14

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC-03882

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-12

January 22, 1971

APOLLO 14
NAVIGATION PROCEDURES

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 71-FM-13

January 21, 1971

LAUNCH WINDOW ANALYSIS IN A NEW PERSPECTIVE, WITH EXAMPLES OF DEPARTURES FROM EARTH TO MARS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

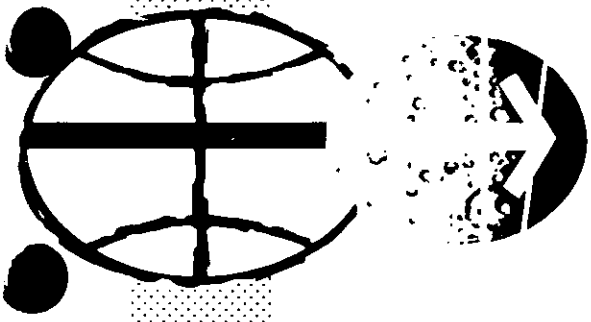
MSC INTERNAL NOTE NO. 71-FM-14

March 24, 1971

A COMPILATION AND ANALYSIS OF SOME OF THE SHUTTLE LAUNCH SITE SELECTION CRITERIA

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

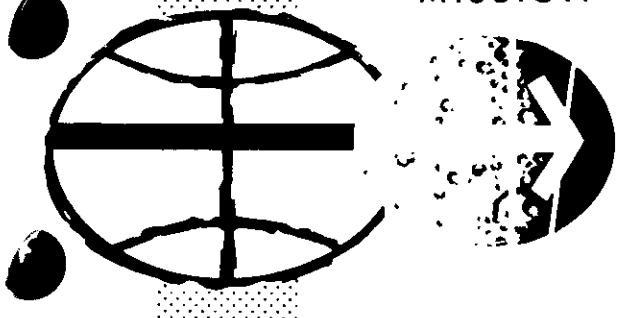
MSC INTERNAL NOTE NO. 71-FM-16

January 19, 1971

ENTRY MISSION PLAN - APOLLO 14 (MISSION H-3)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

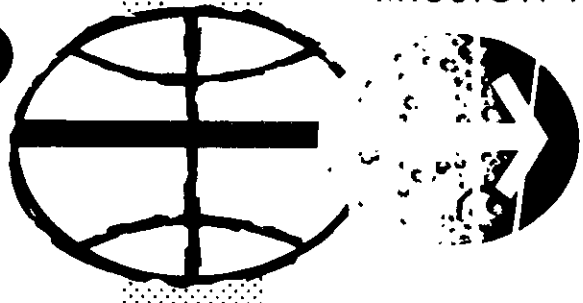
MSC INTERNAL NOTE NO. 70-FM-214

January 27, 1971

BASIC EQUATIONS AND FLOW LOGIC FOR THE RTCC PROCESSOR WHICH DETERMINES A K-FACTOR FOR THE DRAG EQUATIONS DURING THE SKYLAB MISSION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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SCS

CM0029	RGT CONT PITCH	
CM1025	RGT CONT YAW	
CM2029	RGT CONT ROLL	
CM0067	MNTR'D ATT ERR SUM PITCH	+0.0
CM1067	MNTR'D ATT ERR SUM YAW	+0.0
CM0067	DIFF VOLTS PTV	+0.3
CM1067	DIFF VOLTS YTV	+1.0
CM2070	ROLL ATT ERR AMP OUT	+0.1
CM1188	GB BIAS SW	OFF

CREW SAFETY

[illegible]	Q-BALL VECTOR SUM OUT	0.1
[illegible]	LAUNCH VEH SUMD FAIL A	OFF
[illegible]	LIFT OFF SIG A	ON
[illegible]	LIFT OFF SIG B	ON
[illegible]	SEP ABORT IND A	OFF
CS0150	MNTR ALARM	ON

SEQ

CS0007	BARO SW LA-ON A	OPEN
CS0008	BARO SW LA-ON B	OPEN
CS0009	BARO STATIC PRESS	14.6

G & N

CG2004	OGA CDU ERR IND	.213
CG3102	EXT TRUN DR IND	
CG3112	EXT SHFT DR IND	
CG3009	TRUN CDU DR IND	
CG3029	SHFT CDU DR IND	
CG0006	ERROR DETECT	OFF
CG0006	IMU TEMP	OFF
CG0006	IMU DELAY	OFF
CG0021	ASC ACTIVITY ALARM	ON
CG0027	KEY REL ALARM	OFF
CG1101	-28 VDC SUPPLY	-27.0
CG1110	2.5 VDC TM BIAS	2.5
CG1202	IMU OP 28V	ON
CG0009	SUB TRUN CONT IND	
CG0009	SUB SHAFT CONT IND	

EPS

CE0008	BATT MANIF PRESS	
CE0004	BATT CHGR CUR	0.1
CE0014	BATT CHGR OUT V	0.1

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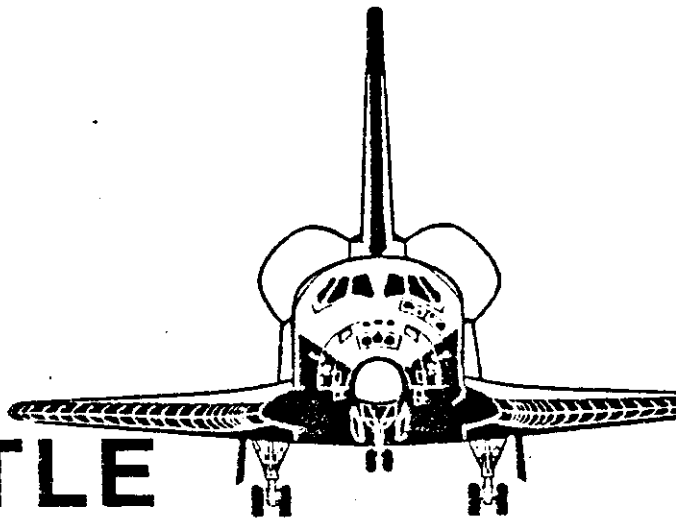

SPACE SHUTTLE LIGHTNING UPSET ANALYSIS

Space Transportation System
Development & Production Division
Space Systems Group

Rockwell International

NARA SW Box E158-1

NASA SW Box E158-1

RD 2137

ASA/ATVC

LIGHTNING PROTECTION

U.S. Government

MEMORANDUM

Lyndon B. Johnson Space Center

NASA

REPLY REF: WA3/83-539	DATE JUN 13 1983	INITIATOR WA3/DLSuiter:mlp:6/10:4323	ENCL 1

TO: LA/Manager, National Space Transportation Systems Program Office
MA/Manager, Space Shuttle Projects Office

FROM: WA3/Chairman, Electromagnetic Effect Panel

CC: AC/H. E. Clements

SIGNATURE: R. L. Blount
Robert L. Blount

SUBJ: Lightning Design Models and Vehicle Lightning Capabilities

The design model contained in the Space Shuttle Lightning Protection Criteria Document - JSC 07636, was selected in the early 1970's on the advice of four lightning consultants. The model is based solely on cloud-to-ground lightning parameters and is very severe in peak current amplitude of 200 kilo amperes (KA). It now appears that the 98 percentile peak current model (100KA) shown in NASA TM 92473, Terrestrial Environme (climate) Criteria Guidelines for Use in Aerospace Vehicle Development - 1982 Revision is a more reasonable level for threats to the vehicles on the ground at KSC. For the stacked vehicle, the threat of a large strike is only present during roll-out since the launch facility lightning rod protects the vehicle during periods of longest exposure.

Additional lightning data have been obtained within the past three years which indicat that the in-flight threat (launch and landing) would be less than 50 KA peak current. There are now data available from 233 strikes to research aircraft and the measured peak currents were all below 22 KA. In addition, there are now measured peak currents from 82 triggered cloud-to-ground strikes from thunderstorms using wire trailing rockets and all were below 48 KA. Thirty (30) of the 82 strikes were from Florida thunderstorms. We believe these data to be adequate justification for revising the in-flight requirement to 50 KA peak current with a 25 KA restrike. This has been discussed with three of the four original consultants who all feel a reduction in requirements is a reasonable thing to do. We will further discuss the lightning threat with other members of the lightning community at the up-coming conference in Ft. Worth, Texas in June.

Following the conference, the Shuttle Lightning Committee is planning to draft propose changes to JSC 07636 to specify two design models that will be compatible with the ground and in-flight threat as is presently known. If these changes are approved the SRB design, including the filament wound case, should meet the new requiremer the ET design, without the protective bands on the ogive, should also meet the new requirements. The Orbiter/SSME design, with the installation of four approved modifications, should meet the new requirements for the damage situation.

The assessment of the Orbiter/SSME circuit upset hardness to lightning using state-of-the-art bench testing techniques, however, is still in progress and is scheduled be completed by August of this year.

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MSC-01540

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ANALYSIS OF
APOLLO 12 LIGHTNING INCIDENT

PREPARED BY

MARSHALL SPACE FLIGHT CENTER

KENNEDY SPACE CENTER

MANNED SPACECRAFT CENTER

FEBRUARY 1970

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JSC-09221

FRANK - PLEASE READ.

ASTP SIMULATED LIGHTNING TEST REPORT

& TAKE TO CENTER CONTROL

FC 1/14

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

November 1974

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CSB APOLLO 14 MANNING

	SHIFT	GNC	EECOM	PROP	G&N	ECS	EPS	SPAN
M. P. Frank	1	G. Coen T. Watson	J. Aaron S. McLendon	T. Semple W. Young	F. Mussato	L. Sheaks	J. Kelly J. Gorman	A. Aldrich W. Blair
M. L. Windler	2	J. Kamman	C. Dumis C. Staresinich	J. Walsh	W. Price R. Freund	J. Byers H. Gregan	C. Jones J. Ward	R. Loe
G. D. Griffin	3	L. Canin J. DeAtkine	S. Liebergot W. Moon	J. Borches	F. DiGenova	G. Conway	R. Brown	N. Hutchinson

Secretarial Badging

K. Spencer
D. Merrell
E. Roberts
A. Brady

SKYLAB ASSIGNMENTS DURING APOLLO 14 TIMEFRAME

C. Burton
G. Bliss
W. Strahle
C. Linn M/M
H. Hoiland M/M
W. Almassey BDX
E. Liebman BDX
B. Levy BDX
S. Leigh MDAC
W. Greenshields MDAC

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ENCLOSURE

71-FC83-034 January 29, 1971

Note of Interest

Apollo 14 Inflight Demonstrations

1. As you may or may not know, there are four inflight demonstrations identified for use on Apollo 14. The purpose of this note is twofold: (1) to briefly acquaint you with the demonstrations, and (2) to explain the ground interface procedures associated with the demonstrations.

2. The demonstrations and development centers are as follows:

a. Heat Flow and Convection MSFC

b. Electrophoretic Separation MSFC

c. Composite Casting MSFC

d. Liquid Transfer LERC

The first three demonstrations comprise simple tests of interest in the Materials Science and Manufacturing in space program and the forth is an evaluation of baffle systems to control weightless fluids during transfer to and from tanks. These demonstrations are jointly sponsored by the OMSF Advanced Manned Missions Program Office and the OART Technology Applications Office. An inflight demonstration, by the way, is a technical demonstration of an apparatus and/or processes designated to illustrate or utilize the unique conditions of the space flight environment. They are performed on a non-interference basis and their completion is not considered as a factor relating to mission success. They do not appear in the Flight Plan, except for a single line entry relating to R/T TV at 172:30 GET. Current crew plans indicate they will be done on the return leg.

3. Heat Flow and Convention Demonstration - One of the principal advantages expected for the processing of materials in space is that there should be no

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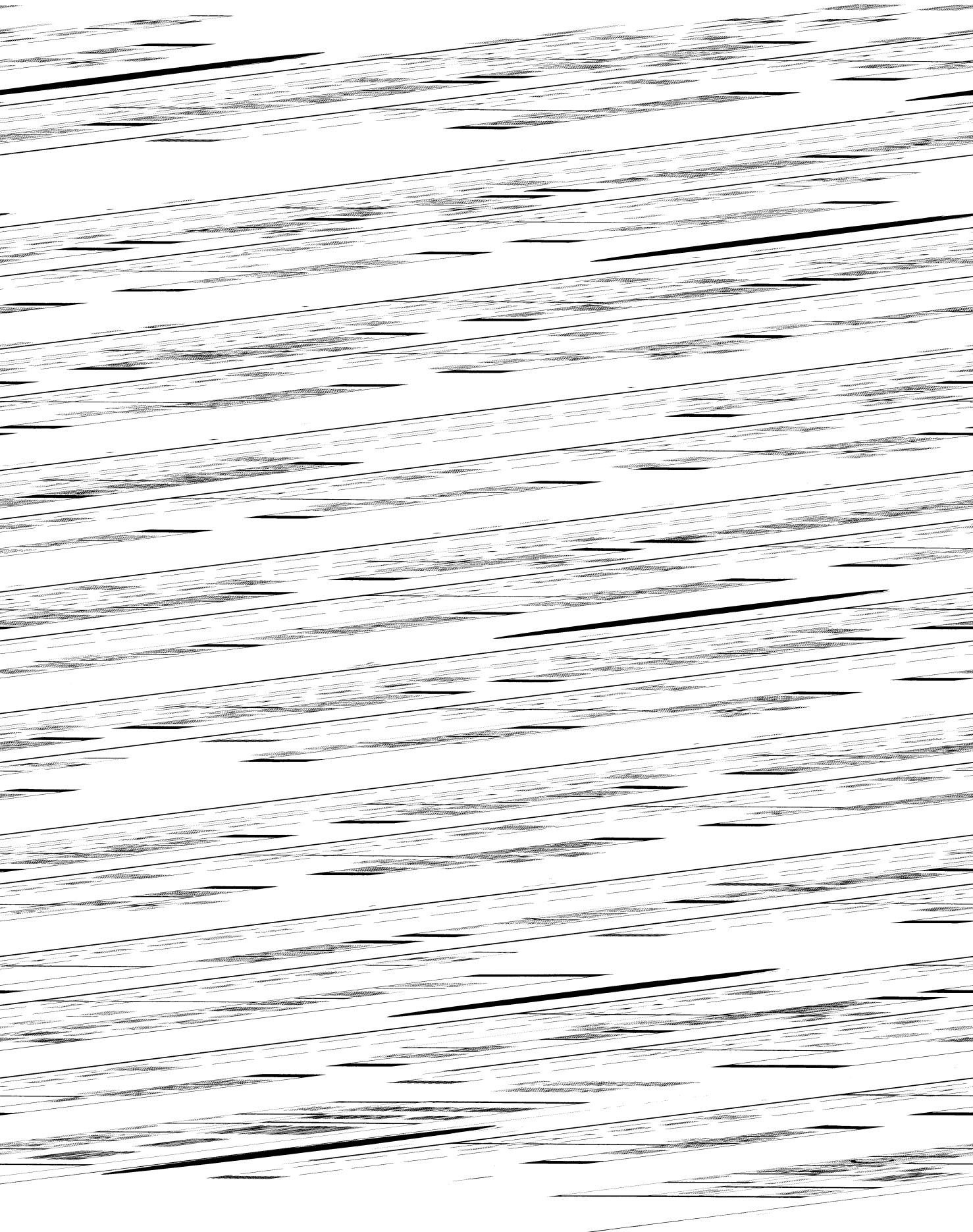

CAPCOM Okay. Copy that.

DUKE Great. Oh, I'm looking forward to tomorrow. I - the day went so fast today, the first thing I knew I didn't have a chance to eat or get a cup of coffee or anything. It was really - really (garble) along here. Doggone exciting.

YOUNG It was pretty interesting. I think we can do a little better on the driving cross sun tomorrow.

CAPCOM Rog. You made good time coming back.

YOUNG Yeah, follow your tracks. That's the only way to fly.

DUKE Hey, Tony, if we're on time, and we got a 7 hour EVA in, what - how come we cut down - where did we lose - we must have lost it somewhere because we only had half the time at Flag - Or Spook, rather.

YOUNG Yeah, I was curious about that, too.

CAPCOM Okay. We got out of Flag about 10 minutes late, really, by the time you were really all loaded up and moving, and I can't remember right now where we lost the rest of the time.

DUKE Okay. Thank you. Let say that all our geology training, I think, has really paid off. Our sampling is really - at least, procedurally - has been real team work, and we appreciate everybody's hard work on our exemplary training.

CAPCOM Okay, and I sure think it's paying off. You guys did an outstanding job.

YOUNG Yeah. You noticed how good I carried the bag, huh?

DUKE Yeah, well, they'll be that way.

YOUNG I got the farts again. I got 'em again, Charlie. I don't know what the hell gives them to me. Certainly not - I think it's acid in the stomach. I really do.

DUKE It probably is.

YOUNG I mean, I haven't eaten this much of that fruit in 10 years. And I'll tell you one thing, on my [illegible] I didn't [illegible] my [illegible]. [illegible] to serve me [illegible] with my breakfast. I'm [illegible] throw up. I like an occasional orange, I really do. But I'll be damned if I'm going to be buried in oranges.

YOUNG I knew all that stuff you're doing would make you work hard.

DUKE [illegible]

YOUNG Well, I don't know what the hell I was doing. You did most of my work. You unloaded the ETB and loaded the ETB and all that stuff.

DUKE [illegible]. I'll tell you what it was. We never practiced that part before - of warming the water

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PROP CONSOLE

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SNA-8-D-027(I)PT 2

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

CSM/LM SPACECRAFT OPERATIONAL DATA BOOK

VOLUME I
CSM DATA BOOK

Part 2, CSM 108 and Subsequent Vehicles
Launch Mission Rule Redlines
SD 68-447-2

Revised October 16, 1972

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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APOLLO 17

DO NOT DISCARD
THIS COPY BASELINE FOR
ALL LAUNCH DATES

~~FINAL~~
CHANGE A

FLIGHT PLAN

PREPARED BY

FLIGHT PLANNING BRANCH

CREW PROCEDURES DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

~~OCTOBER 23, 1972~~
NOV 20, 1972

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 17

ALL LAUNCH DATES

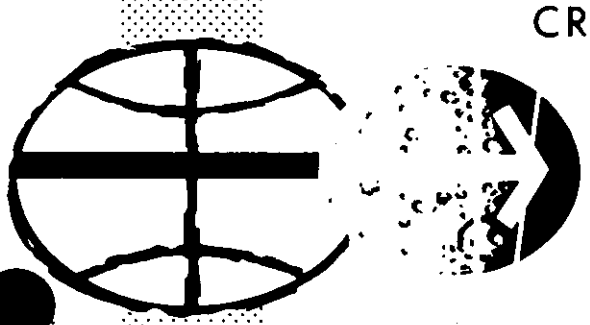
CHANGE A

CSM EXP/EVA CHECKLIST

PREPARED BY

EVA & EXPERIMENTS BRANCH

CREW PROCEDURES DIVISION



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NOVEMBER 8, 1972

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F. DIGENOVA

MSC-07197
Volume I

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 72-FM-187

August 18, 1972

SPACECRAFT OPERATIONAL TRAJECTORY

APOLLO 17

LAUNCH DECEMBER 6, 1972, C.S.T.

(DECEMBER 7, 1972, G.M.T.)

VOLUME I - MISSION PROFILE

AMEND 1

Mission Integration Branch,
Flight Performance Branch,
and Guidance and Dynamics Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

APOLLO 18

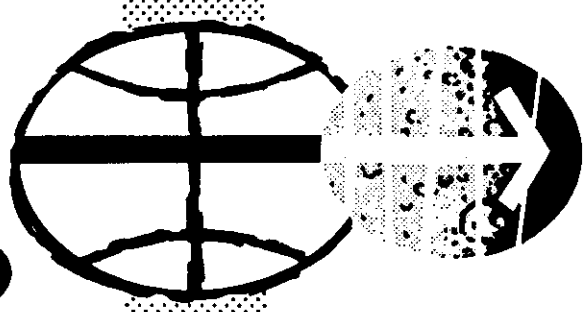
FLIGHT CREW EXPERIMENTS GUIDE

PREPARED BY

EXPERIMENTS SECTION

MISSION OPERATIONS BRANCH

FLIGHT CREW SUPPORT DIVISION



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FRETRE

JSC-09459

FILE 1-3

ASTP

Flight Mission Rules

NOVEMBER 14, 1974

Prepared by

FLIGHT CONTROL DIVISION

Flight Operations Directorate

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

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JSC-09153

ASTP

FINAL

~~PCN-4~~ PCN 5
7/9/75 P&I

NOTE: This is a PAGE CHANGE NOTICE to be incorporated into the previous edition for the 4th & 5th LAUNCH OPPORTUNITIES as indicated

CUE CARDS

PREPARED BY
PROCEDURES BRANCH
CREW TRAINING & PROCEDURES DIVISION

National Aeronautics and Space Administration
LYNDON B. JOHNSON SPACE CENTER
Houston, Texas

JULY 8, 1975

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Jack Kamman

SECOND EDITION

TRANSLATION AND EXPLANATION OF SOYUZ CONTROL PANELS

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

AUGUST 14, 1974

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ATMOSPHERE AND GAS COMPOSITION CONTROL

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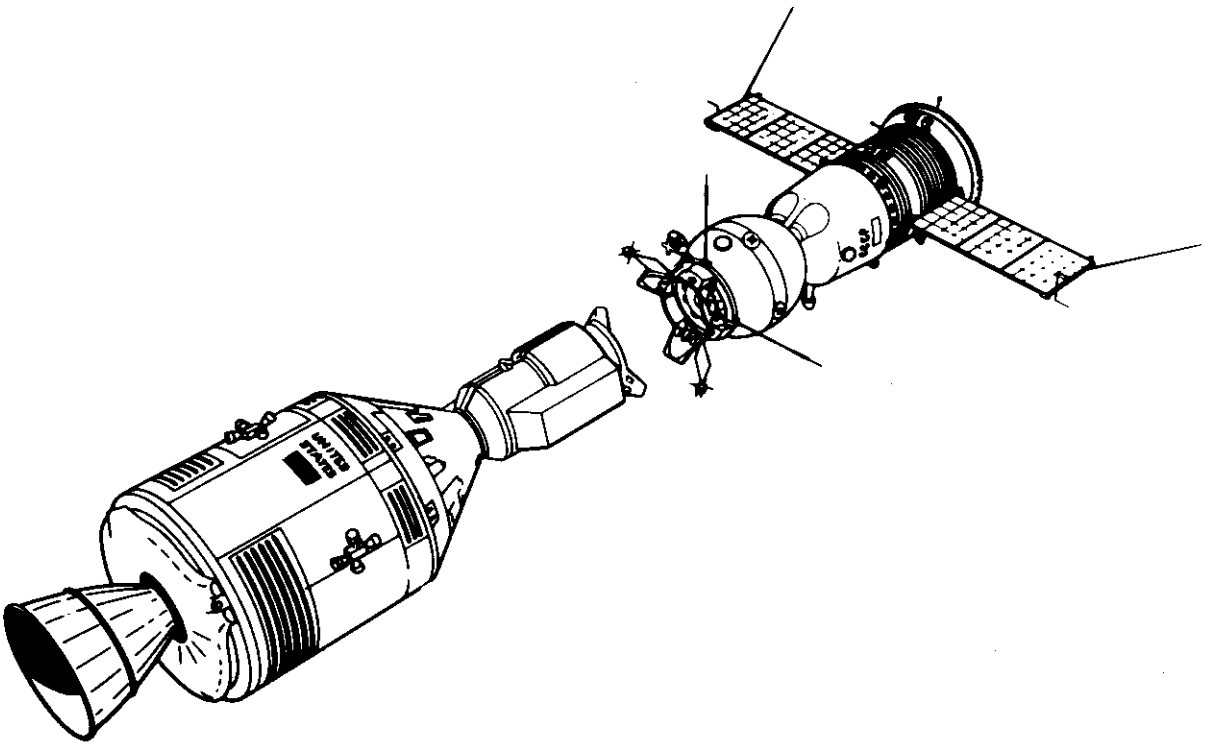

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GRN SSR

5520.5-208

CONSOLE

FUNCTIONAL DESCRIPTION OF AGC DOWNLINK

F. Di Genova

FOR COLOSSUS 3 CSM PROGRAM

Based on Artemis 072 CMC Program

4 May 1971

MTCP Task A-201

NAS 9-8166

WORKING PAPER

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APOLLO SOYUZ TEST PROGRAM

SYSTEM DESCRIPTION MANUAL

CSM 111/DOCKING MODULE

SECTION II
OVERVIEW

2.1 STRUCTURES AND DOCKING

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APOLLO SOYUZ TEST PROGRAM

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OVERVIEW

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CSM 111/DOCKING MODULE

SECTION II
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2.3 SEQUENTIAL EVENTS CONTROL

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INSTRUCTOR: C.O. Steele

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APOLLO SOYUZ TEST PROGRAM

SYSTEM DESCRIPTION MANUAL

CSM 111/DOCKING MODULE

SECTION II
OVERVIEW

2.6 GUIDANCE AND CONTROL

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Bill Ruffin 4/25/75
(w.o)

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The Charles Stark Draper Laboratory
68 Albany Street, Cambridge, Massachusetts 02139 Telephone (617) 864-6900

SKYLARK MEMO NO. 97

TO: Distribution

FROM: R. Larson, R. Kiburz, et al

DATE: 2 April 1973

SUBJECT: SKYLARK Erasable Procedures (SEP's) for Use On Mission SL-2

The attached procedures have been received/developed by MIT/CSDL and are being circulated for general information.

SKYLARK EMP's are not included in the memo other than the reference in the CONTENTS. They appear in Section 7 of the GSOP, R-693.

The IMU Failure Rendezvous Procedures were reviewed in the CSM Rendezvous Book (R6-1). It is not included in this memo.

SEP 017 (SL-51) has not appeared in the G & C checklist as yet, however, MIT has reviewed preliminary issues of the new Section 7.

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MASS. INST. OF TECHNOLOGY

APOLLO

GUIDANCE, NAVIGATION AND CONTROL

Submitted by: Mayo H. Hamilton Date 6/18/75

M. H. HAMILTON, DIRECTOR, MISSION PROGRAM DEVEL.
APOLLO/SOYUZ TEST PROJECT

Approved: R. A. Larson Date 6/18/75

R. A. LARSON, SKYLARK PROJECT MANAGER
APOLLO/SOYUZ TEST PROJECT

Approved: R. H. Battin Date 6/17/75

R. H. BATTIN, DIRECTOR, MISSION DEVELOPMENT
APOLLO/SOYUZ TEST PROJECT

Approved: N. E. Sears Date 6-18-75

N. E. SEARS, HEAD NASA/ARMY PROGRAMS DEPARTMENT
CHARLES STARK DRAPER LABORATORY, INC.

R-693

GUIDANCE SYSTEM OPERATIONS PLAN
APOLLO SOYUZ TEST PROJECT
USING PROGRAM SKYLARK 1

SECTION 7 ERASABLE MEMORY PROGRAMS
REV. 03

June 1975

MIT INSTRUMENTATION LABORATORY

CAMBRIDGE 39, MASSACHUSETTS

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ANDROGYNOUS PERIPHERAL
DOCKING SYSTEM

MARCH 1974

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25990-H051-R0-00

PROJECT TECHNICAL REPORT

TASK ASTP-E101

CSM DIGITAL AUTOPILOT TESTING IN SUPPORT OF ASTP EXPERIMENTS CONTROL REQUIREMENTS

NAS 9-13834

15 JANUARY 1975

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

Prepared by
D. L. Rue

Approved by R. L. Haken
R. L. Haken, Manager
Task ASTP-E101

Approved by W. B. Warren
W. B. Warren, Manager
Subsystem Engineering and
Analysis Department

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FRANK DiGENOVA

JSC-09085

PA-N6-10100-1

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FILE 1/5

Command/ Service Module

DC-1

and Docking Module

SYSTEMS HANDBOOK - CSM 111

AUGUST 1, 197

1 STANDARDS

2 SEQUENTIAL EVENTS SYSTEM

3 ELECTRICAL SYSTEM

4 ENVIRONMENTAL CONTROL SYSTEM

5 FUEL CELL/ CRYOGENIC SYSTEM

6 COMMUNICATIONS SYSTEM

7 INSTRUMENTATION

8 GUIDANCE AND CONTROL SYSTEM

9 SERVICE PROPULSION SYSTEM

10 REACTION CONTROL SYSTEM

11 CM AND DM EXPERIMENTS

12 SM EXPERIMENTS

13 MISCELLANEOUS

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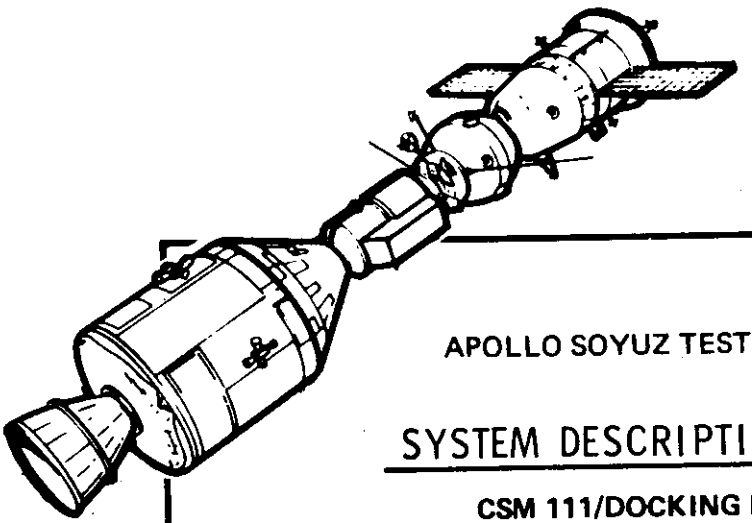

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SYSTEM DESCRIPTION MANUAL

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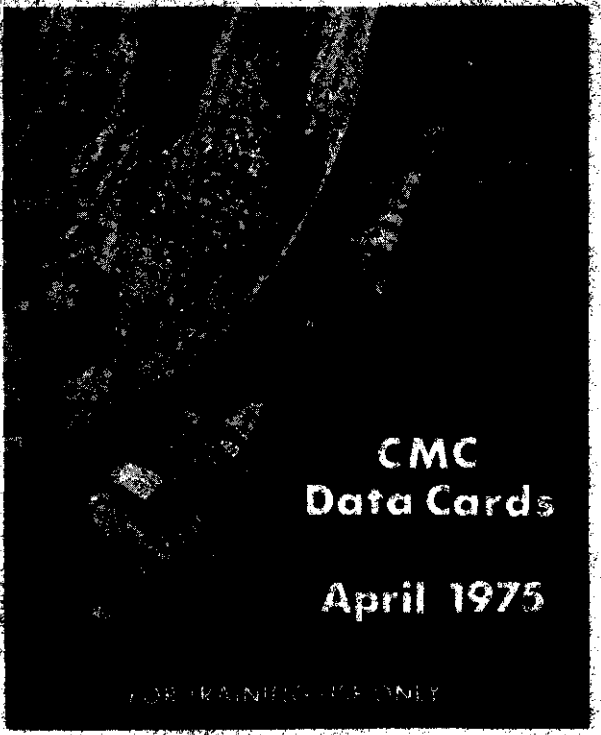

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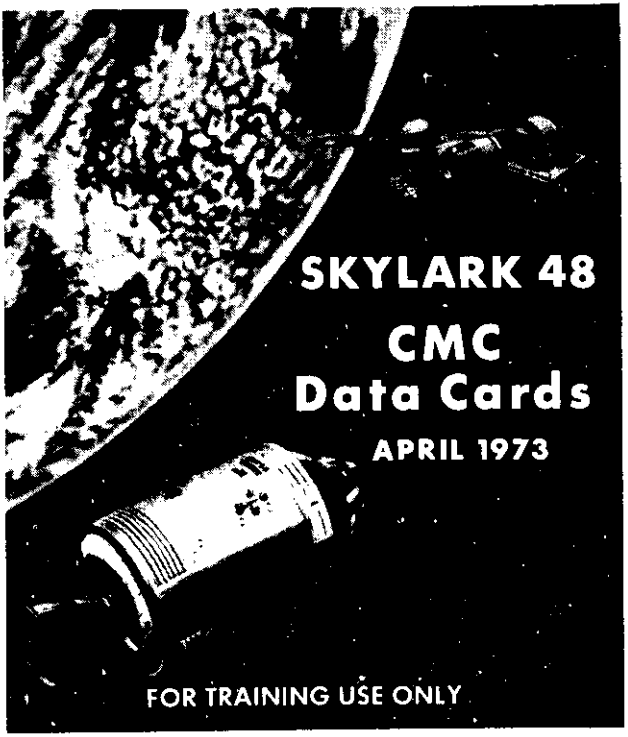

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CM PRIMARY GUIDANCE NAVIGATION AND CONTROL SYSTEM

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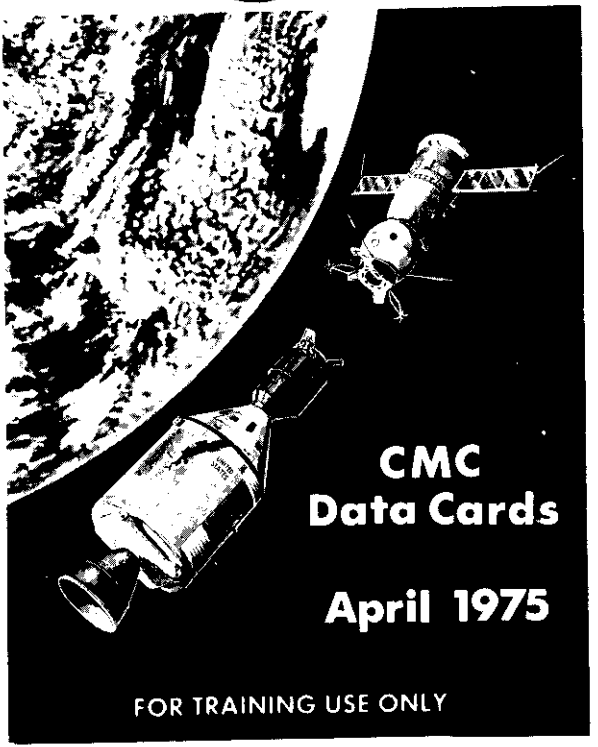

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APOLLO SOYUZ TEST PROGRAM MISSION PROGRAM REQUIREMENTS FOR THE REAL-TIME COMPUTER COMPLEX

Prepared for

National Aeronautics and Space Administration

Lyndon B. Johnson Space Center

PHILCO Ford

Philco-Ford Corporation
Aerospace and Communications Operations
WDL Division, Houston Operation

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F. DIGENOVA JSC-08469

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APOLLO - SOYUZ TEST PROJECT

OPERATIONS HANDBOOK COMMAND/SERVICE MODULES

CSM 111

OPERATIONAL PROCEDURES

PREPARED BY
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UNDER DIRECTION
OF
CREW PROCEDURE DIVISION

CONTRACT NAS9-13100
SD 72-CS-0040
DRL LINE ITEM NO. 9

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SD 73-CS-0053

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LANDING SYSTEMS APPLICABLE

TO

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FOR THE EXPOSURE OF MAN TO

SPACE RADIATIONS

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PROJECT APOLLO

A GENERAL DESCRIPTION OF THE LUNAR EXCURSION VEHICLE'S SYSTEMS FOR EXCURSIONS FROM LUNAR ORBIT TO LUNAR LANDING AND BACK TO LUNAR ORBIT

Declassified by authority of
Ltr. G. L. Smart
NASA-SCB 7/11/72
this date JUN 19 1972

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APOLLO SPACECRAFT RESEARCH AND DEVELOPMENT

INSTRUMENTATION SYSTEMS

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AS OF OCTOBER 2, 1961

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A HYPOTHETICAL MODEL OF THE LUNAR SURFACE FOR THE ENGINEERING DESIGN OF TERMINAL TOUCHDOWN SYSTEMS

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STATIC LONGITUDINAL STABILITY CHARACTERISTICS OF A MODIFIED ATMOSPHERIC ABORT CONFIGURATION FOR PROJECT APOLLO

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PROJECT APOLLO

EFFECTS OF A NUMBER OF MODIFICATIONS ON THE STATIC STABILITY OF THE APOLLO ATMOSPHERIC ABORT CONFIGURATION

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NASA PROJECT APOLLO WORKING PAPER NO. 1045

PROJECT APOLLO

A COMPENDIUM OF SOME SPACECRAFT SYSTEMS STUDIES RELATING TO THE MANNED LUNAR LANDING USING LUNAR ORBITAL RENDEZVOUS

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PROJECT APOLLO

SOME CALCULATIONS OF THE REENTRY ENVIRONMENT OF THE APOLLO COMMAND MODULE

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PROJECT APOLLO

STATIC LONGITUDINAL STABILITY CHARACTERISTICS OF THE LITTLE JOE II - APOLLO LAUNCH ESCAPE CONFIGURATION

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NASA Project Apollo Working Paper No. 1049

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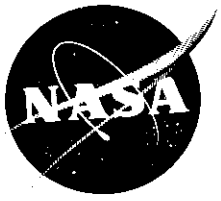

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ATTENUATION OF CORPUSCULAR RADIATION THROUGH SHIELDING

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NASA Project Apollo Working Paper No. 1052

PROJECT APOLLO

A PRELIMINARY ANALYSIS OF THE EFFECTS OF EXHAUST IMPINGEMENT ON THE LUNAR SURFACE DURING THE TERMINAL PHASES OF LUNAR LANDING

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NASA Project Apollo Working Paper No. 1053

PROJECT APOLLO

A STUDY OF HEAT TRANSFER AND PRESSURE DATA OBTAINED ON THE 0.02 APOLLO MODEL IN THE JET PROPULSION LABORATORY 21-INCH HYPERSONIC WIND TUNNEL

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PROJECT APOLLO

PRESSURIZED GAS REACTION CONTROL SYSTEM

FOR LITTLE JOE II

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NASA Project Apollo Working Paper No. 1055

PROJECT APOLLO

CONSIDERATIONS TOWARD THE SELECTION

OF ELECTRICAL POWER SYSTEMS

AND

THERMAL CONTROL SYSTEMS

FOR THE

LUNAR EXCURSION MODULE

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PROJECT APOLLO

CRYOGENIC STORAGE OF FUEL CELL REACTANTS AND ENVIRONMENTAL SYSTEM SUPPLIES

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NASA Project Apollo Working Paper No. 1058

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NASA Project Apollo Working Paper No. 1058A

PROJECT APOLLO

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PROJECT APOLLO

DESIGN DATA BOOK VOLUME II

APOLLO, SATURN C-5, LAUNCH VEHICLE

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PROJECT APOLLO

EVALUATION OF ABLATION HEAT SHIELD MATERIAL SPECIMENS INCORPORATING ELECTRICAL CONNECTORS

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PROJECT APOLLO

A PREDICTIVE REENTRY CONTROL AND GUIDANCE SYSTEM STUDIED ON A PILOTED FIXED-BASE ANALOG REENTRY SIMULATOR

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EXTERNAL PRESSURE BUCKLING OF THIN CONICAL FRUSTUMS OF 30° HALF ANGLE

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PROJECT APOLLO FLIGHT MISSION DIRECTIVE FOR MISSION A-001 (U)

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APPLICATION OF THE MATCHED CONIC MODEL IN THE STUDY OF CIRCUMLUNAR TRAJECTORIES

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A STUDY OF THE HEAT TRANSFER DATA OBTAINED ON THE 0.045 APOLLO MODEL IN THE MACH 10 TUNNEL C AT THE ARNOLD ENGINEERING DEVELOPMENT CENTER

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NASA Project Apollo Working Paper No. 1051

PROJECT APOLLO

SPACECRAFT PRELAUNCH AUTOMATIC

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PRELIMINARY SURVEY OF RETROGRADE VELOCITIES REQUIRED FOR INSERTION INTO LOW LUNAR ALTITUDE ORBITS

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PROJECT APOLLO

A COMPILATION OF WORLDWIDE TRACKING AND COMMUNICATION FACILITIES OFFERING POSSIBILITIES FOR USE IN PROJECT APOLLO

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PROJECT APOLLO

PRELIMINARY ANALYSIS OF THE FUEL WEIGHT REQUIREMENTS FOR MISSION ABORT AT EARTH ESCAPE VELOCITY

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PROJECT APOLLO

PRELIMINARY INVESTIGATION OF GROUND TRACKING AND COMMUNICATION SYSTEMS ADAPTABLE FOR USE IN PROJECT APOLLO

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PROJECT APOLLO

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PROJECT APOLLO

PRELIMINARY STUDY OF A PULSE CODE MODULATION TELEMETRY LINK FOR PROJECT APOLLO

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PROJECT APOLLO

SUMMARY OF STUDIES OF A LENTICULAR VEHICLE CAPABLE OF ENTRY FROM A LUNAR MISSION

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PROJECT APOLLO

SPACE TASK GROUP STUDY REPORT

February 15, 1961

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STATIC LONGITUDINAL STABILITY CHARACTERISTICS OF A BLUNT SYMMETRICAL REENTRY CONFIGURATION AND A TOWER-MOUNTED-ROCKET ATMOSPHERIC ABORT CONFIGURATION WHICH MEET THE APOLLO MISSION REQUIREMENTS

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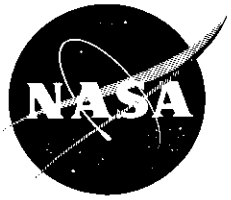

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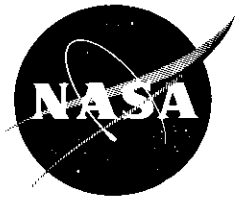

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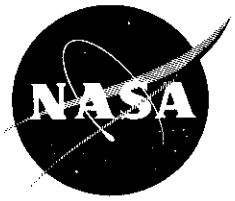

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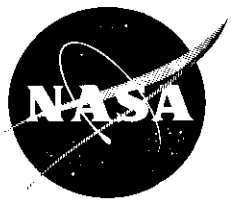

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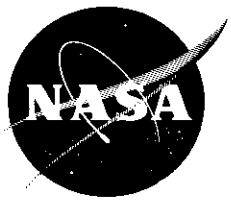

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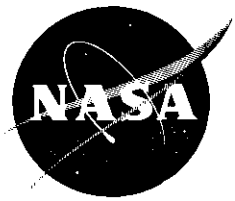

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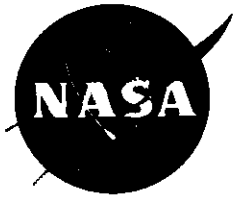

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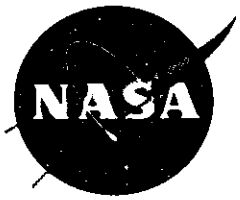

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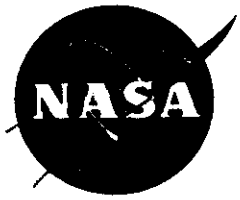

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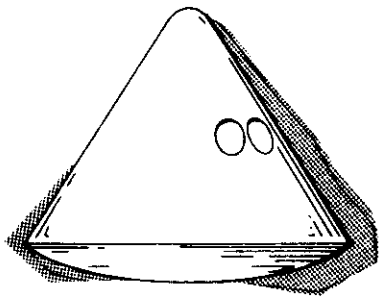

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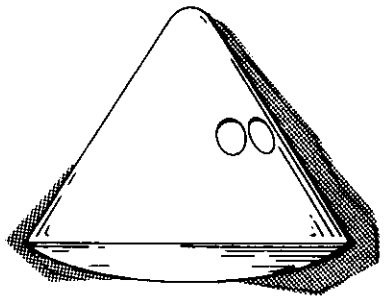

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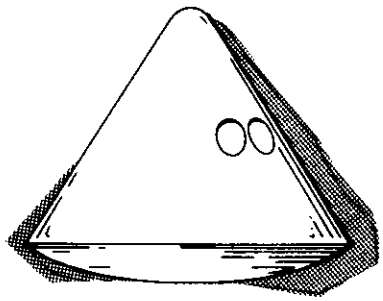

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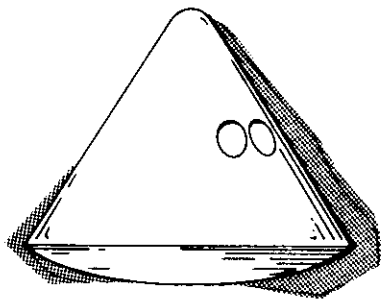

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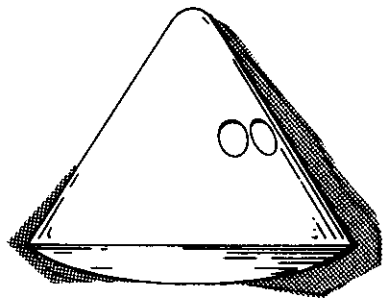
STUDY OF THE ATTITUDE CONTROL HANDLING QUALITIES OF THE LEM DURING THE FINAL APPROACH TO LUNAR LANDING



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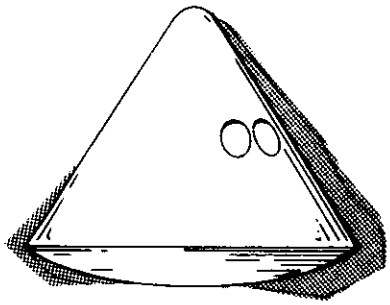
PRELIMINARY STUDY OF THE PILOT-CONTROLLED LEM DOCKING MANEUVER



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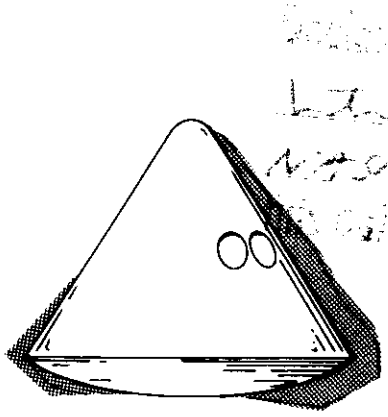

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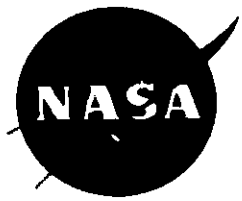

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NASA PROJECT APOLLO WORKING PAPER NO. 1078

AN APPROXIMATE METHOD OF CALCULATING THE ANGLE OF ATTACK RESPONSE OF THE C-1 VEHICLE DUE TO WINDS MEASURED PRIOR TO LAUNCH

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NASA PROJECT APOLLO WORKING PAPER No. 1079

PROJECT APOLLO

STATIC LONGITUDINAL CHARACTERISTICS OF THE PRODUCTION LITTLE JOE II-APOLLO CONFIGURATION WITH CONTROL SURFACES ON THE BOOSTER FINS

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APOLLO-SATURN I LAUNCH PROBABILITY BASED ON WINDS ALOFT

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STUDY OF EARTH ORBIT SIMULATION OF LUNAR ORBIT RENDEZVOUS

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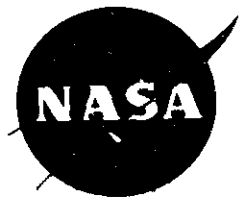

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NASA Project Apollo Working Paper No. 1085

PROJECT APOLLO FLIGHT MISSION DIRECTIVE FOR FIRST SATURN/APOLLO LAUNCH EXIT ENVIRONMENT APOLLO MISSION A-101

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FOR FIRST SATURN/APOLLO LAUNCH EXIT ENVIRONMENT

APOLLO MISSION A-101

(BP-13)

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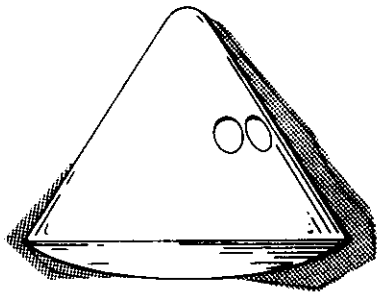
NASA Project Apollo Working Paper No. 1065

PROJECT APOLLO

A THEORETICAL ANALYSIS OF THE TELEMETRY COMMUNICATION SYSTEM FOR THE APOLLO RESEARCH AND DEVELOPMENT PROJECT



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APOLLO MEASUREMENT REQUIREMENTS

APOLLO MISSION A-004

SC002/LITTLE JOE II

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APOLLO S/C MEASUREMENT REQUIREMENTS

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MISSION A-102 (BP-15)

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APOLLO LEM MEASUREMENTS REQUIREMENTS

LUNAR EXCURSION MODULES 4 THRU 10

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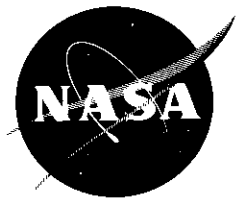

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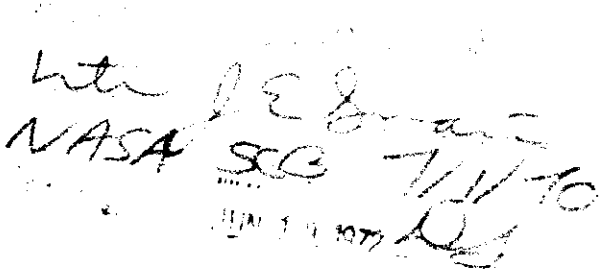

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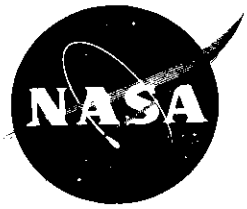

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APOLLO SC MEASUREMENT REQUIREMENTS

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APOLLO SC MEASUREMENT REQUIREMENTS

APOLLO MISSION A-202

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CONSIDERATIONS TOWARD THE SELECTION OF SUPERCRITICAL CRYOGENIC FLUID ANTI-STRATIFICATION SYSTEMS FOR APOLLO COMMAND AND SERVICE MODULE

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FOR

APOLLO MISSION A-002

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APOLLO S/C MEASUREMENT REQUIREMENTS

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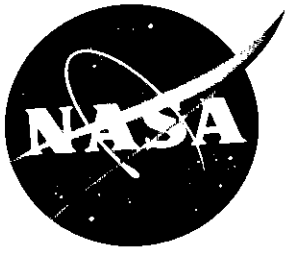

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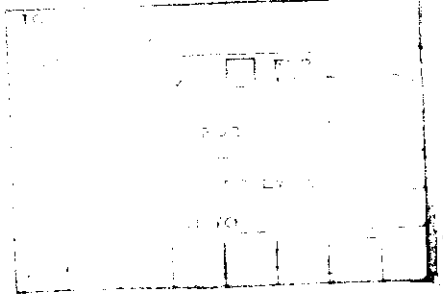

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LUNAR EXCURSION MODULE VISIBILITY REQUIREMENTS

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ANGLE-OF-ATTACK RESPONSE AND LAUNCH PROBABILITIES OF THE APOLLO/SATURN V VEHICLE DUE TO WINDS ALOFT (U)

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OPTIMIZED CM/SM PERFORMANCE TO LUNAR EQUATORIAL LANDING SITES FOR 7-, 8-, AND 9-DAY MISSIONS LAUNCHED DAILY DURING THE FIRST 45 DAYS OF 1968 (U)

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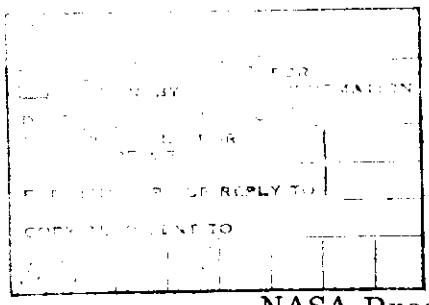

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Ltr. J. L. Smart
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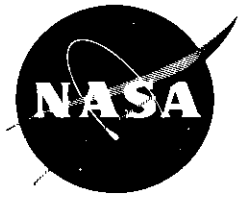

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Charles M. Grant, Jr.
Chief, Technical Information Division

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NASA Program Apollo Working Paper No. 1127

PROGRAM APOLLO FLIGHT MISSION DIRECTIVE

FOR SECOND SATURN/APOLLO LAUNCH EXIT ENVIRONMENT

APOLLO MISSION A-102

(BP-15)

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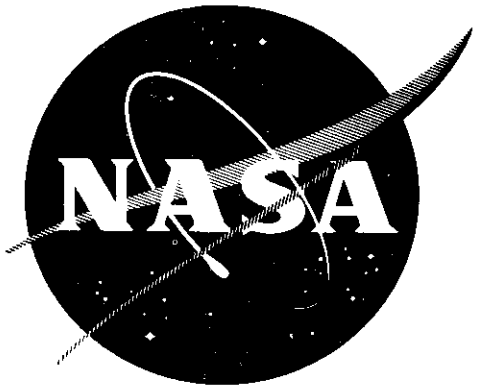

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APOLLO MEASUREMENT REQUIREMENTS

BOILERPLATE 15

APOLLO MISSION A-102

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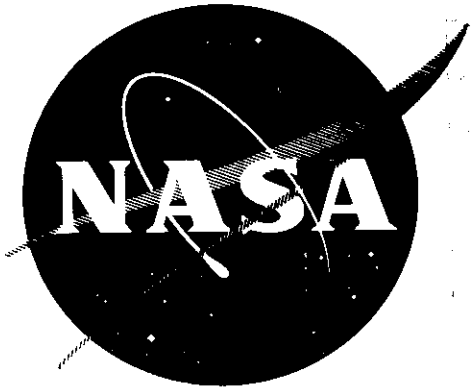

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APOLLO MEASUREMENT REQUIREMENTS

BOILERPLATE 23

APOLLO MISSION A-002

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APOLLO MEASUREMENT REQUIREMENTS

BOILERPLATE 22

APOLLO MISSION A-003

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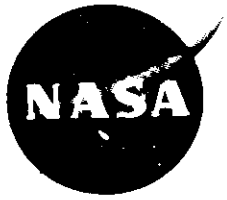

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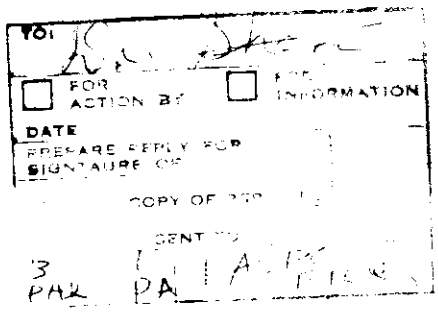

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APOLLO MEASUREMENT REQUIREMENTS

APOLLO MISSION PA-2

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APOLLO MEASUREMENT REQUIREMENTS

APOLLO MISSION PA-2

BOILERPLATE 23A

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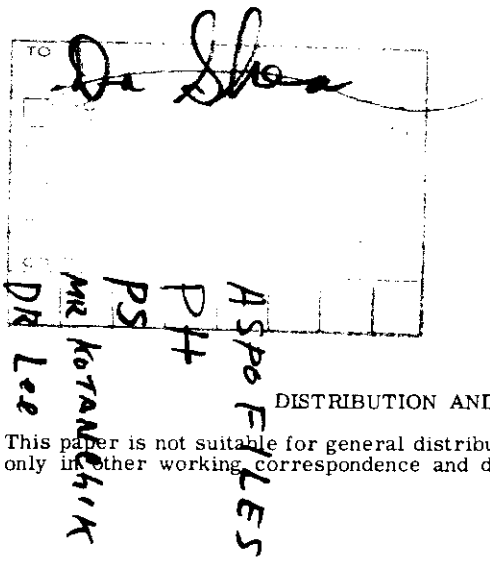

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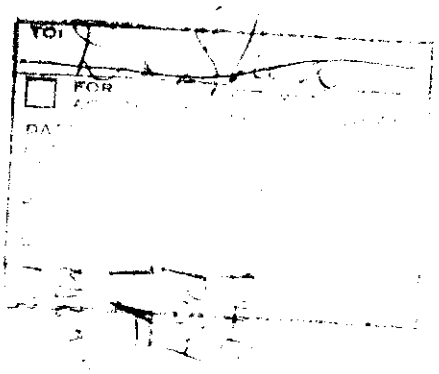

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APOLLO SPACECRAFT LIQUID PRIMARY PROPULSION SYSTEMS

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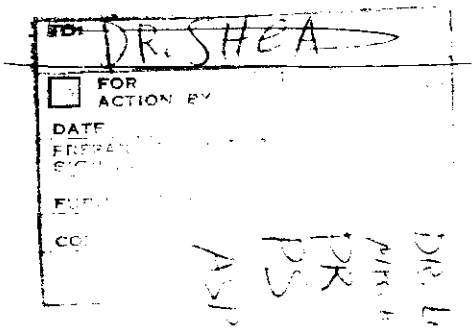

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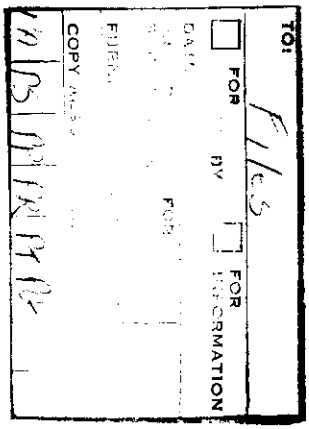

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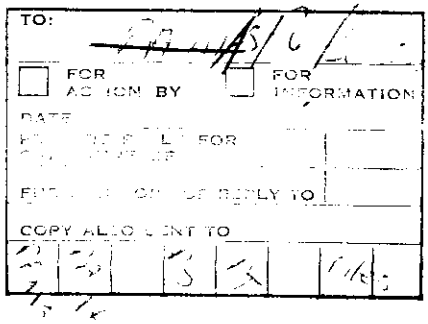

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BOILERPLATE 22 SPACECRAFT

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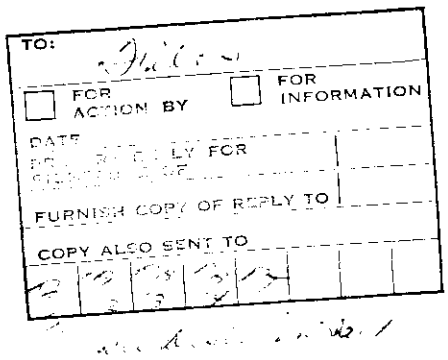

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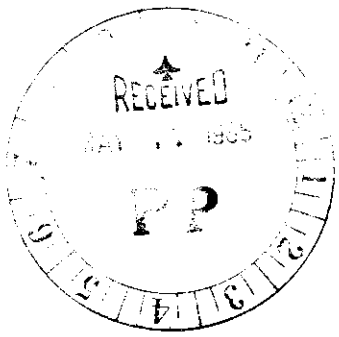

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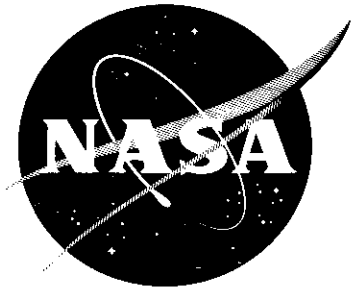

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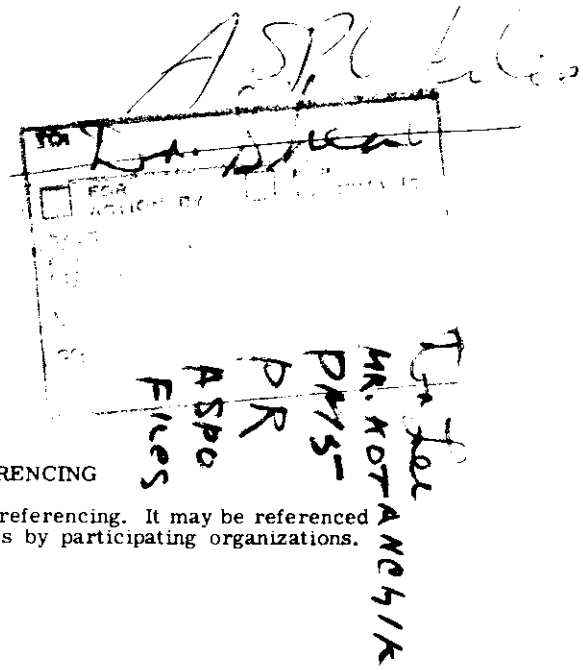

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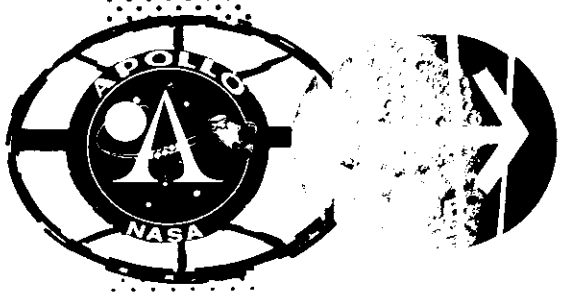

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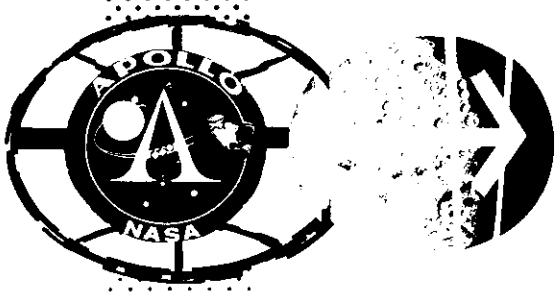

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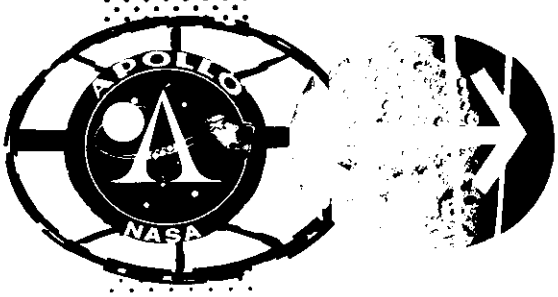

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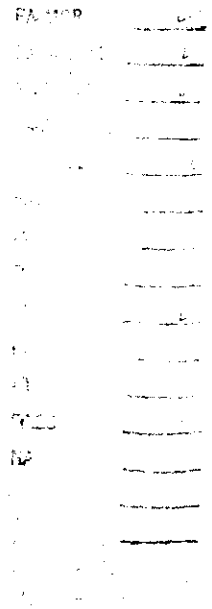

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NONFLAMMABLE FLUOREL COMPOUNDS

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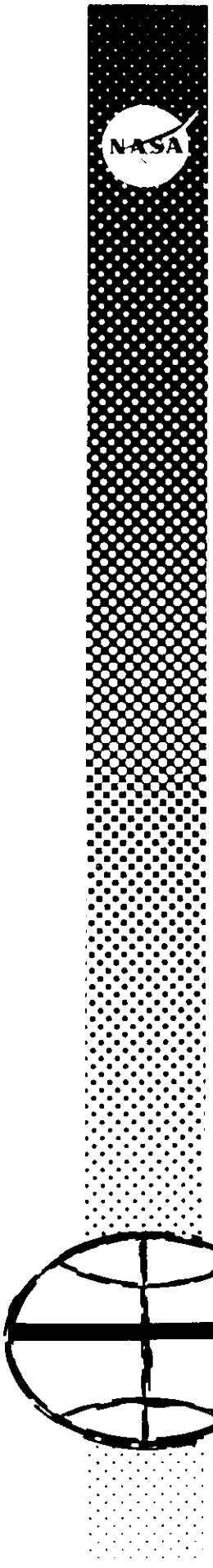

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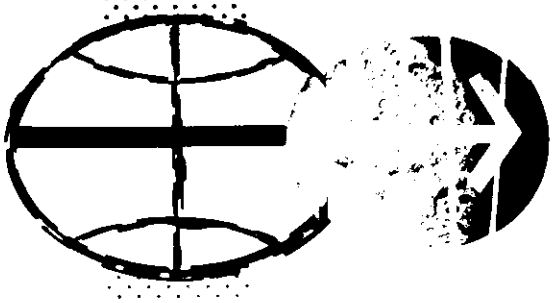

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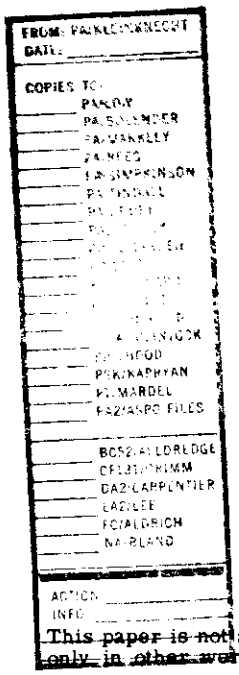
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PHASE I

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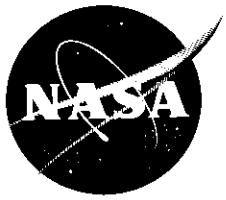

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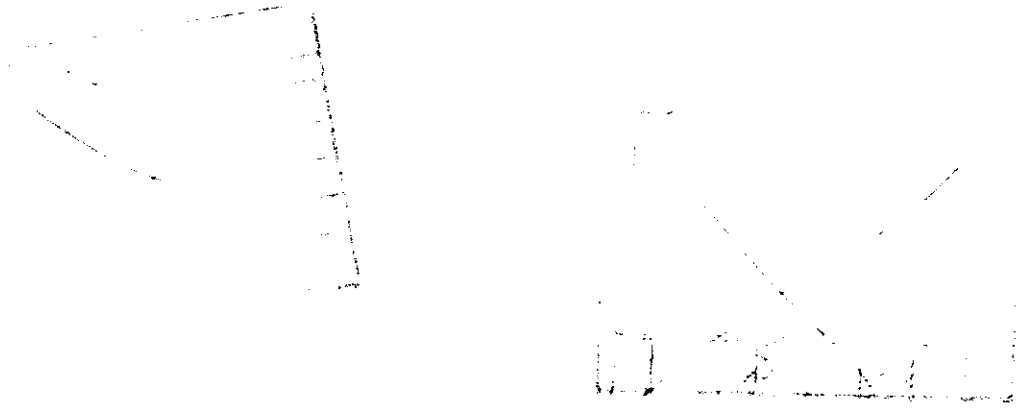

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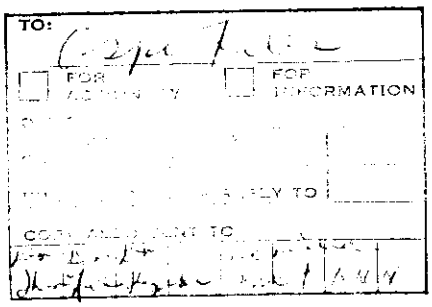

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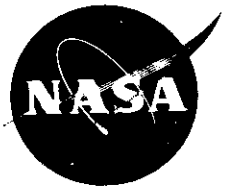

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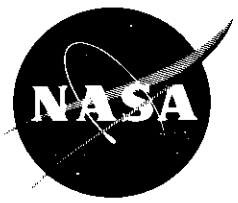

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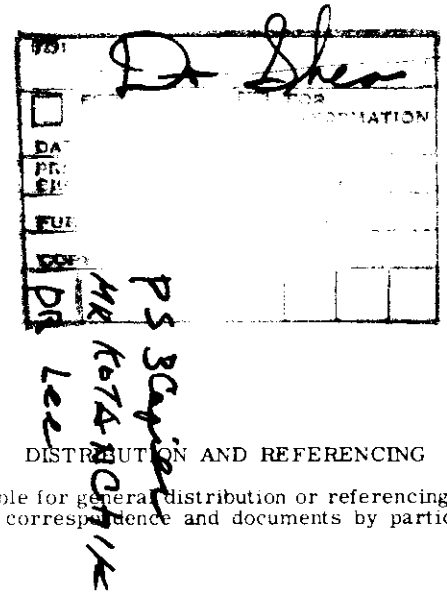

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SELECTION AND CHARACTERISTICS OF THE RADIOISOTOPE POLONIUM-210 AS AN ELECTRICAL POWER SYSTEM HEAT SOURCE FOR APOLLO EXTENSION SYSTEMS MISSIONS

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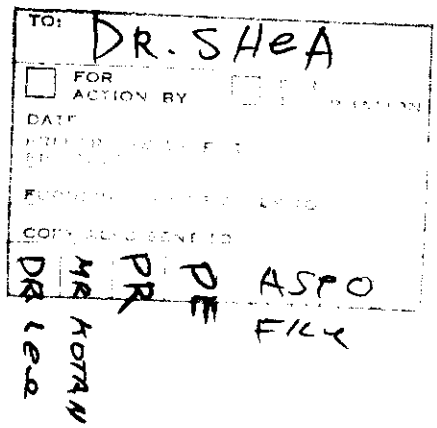

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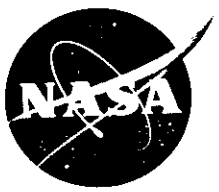

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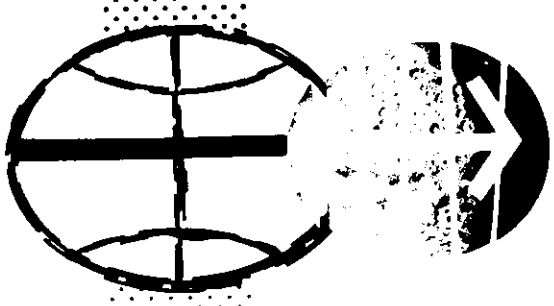

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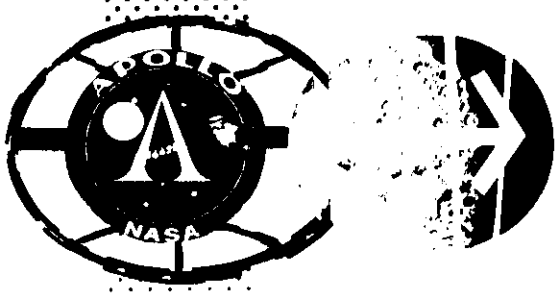

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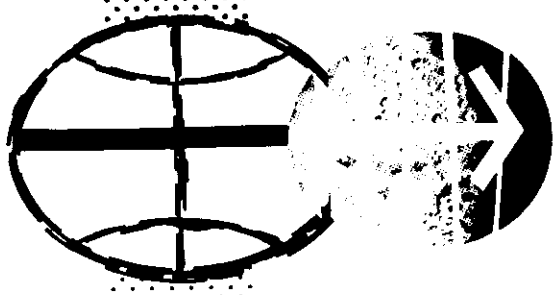

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APOLLO LUNAR MODULE ALINEMENT OPTICAL TELESCOPE EVALUATION

PA-MGR
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PA-M,LM
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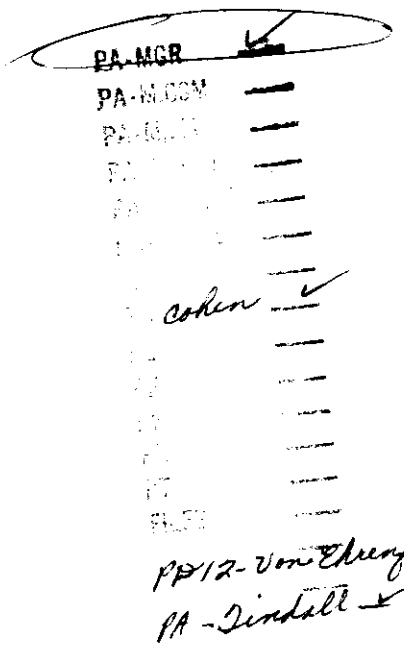

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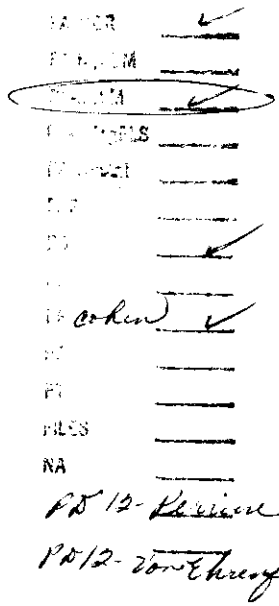

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CSM DIGITAL AUTOPILOT (RCS MODES) USING PROGRAM SUNDISK

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PROJECT APOLLO

A STUDY OF THE ALTITUDE WEIGHTING FUNCTION FOR THE LM POWERED DESCENT ONE-PHASE GUIDANCE

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December 12, 1968

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PA-M,LM ✓
PA-A,M[illegible]S —
PA-[illegible]ast —
PA2 —
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INTERNAL NOTE NO. MSC-EP-R-68-17

APOLLO LUNAR MODULE REACTION CONTROL SUBSYSTEM TEST

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Propulsion and Power Division
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October 1, 1968

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MSC Internal Note EG-68-2

Project Apollo

VISUAL DETECTION OF THE LANDED LUNAR MODULE BY THE APOLLO COMMAND MODULE OPTICS

Prepared by: Charles E. Manry

Charles E. Manry
Guidance Development Branch

Approved by: Paul E. Ebersole

Paul E. Ebersole, Chief
Guidance Development Branch

Approved by: Robert G. Chilton

Robert G. Chilton, Deputy Chief
Guidance and Control Division

National Aeronautics and Space Administration

Manned Spacecraft Center

Houston, Texas

February 5, 1968

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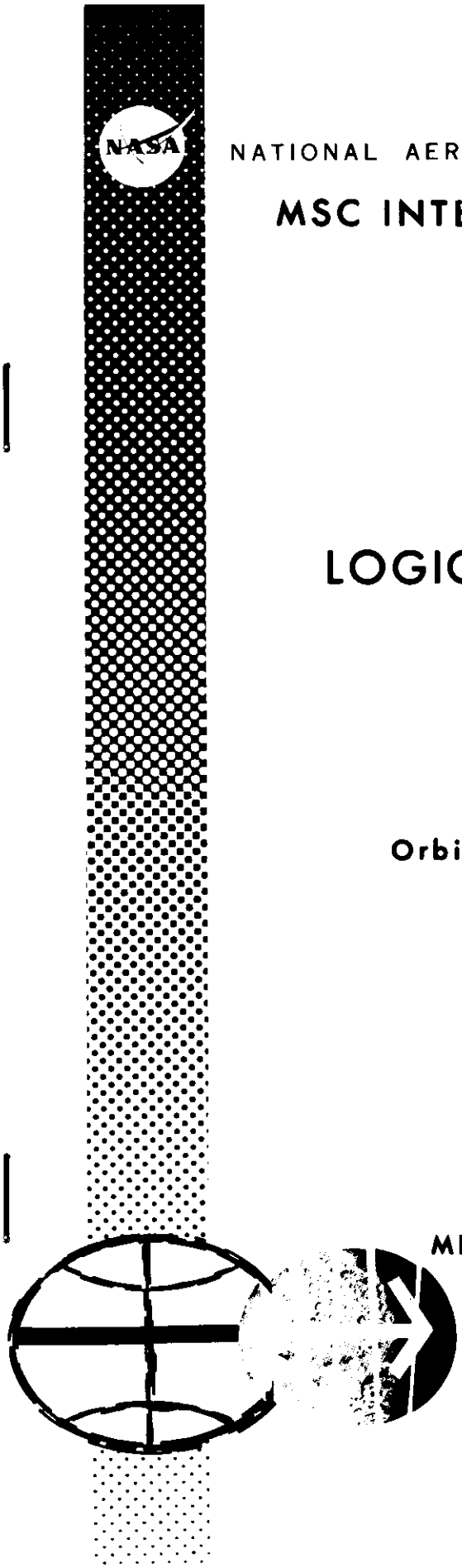

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MSC INTERNAL NOTE NO. 68-FM-3

January 4, 1968

LOGIC FOR THE REAL-TIME THRUST MODEL

By Ernest M. Fridge
and Dennis M. Braley
Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-8

January 8, 1968

A PRELIMINARY MONTE CARLO DISPERSION ANALYSIS ON THE LUNAR LANDING MISSION

By Joe W. Nolley,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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05952-H370-R0-00

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MSC INTERNAL NOTE NO. 68-FM-10

January 10, 1968

THE REAL-TIME AUXILIARY COMPUTING FACILITY LV-204/LM-01 (APOLLO 5) OPERATIONAL SUPPORT TEAM HANDBOOK

By Mission Operations Section
TRW Systems Group

MSC Subtask Monitor
L. D. Davis

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PD- Cohen
PD7 - Lilley

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MSC INTERNAL NOTE NO. 68-FM-12

January 15, 1968

LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF A SATELLITE EPHEMERIS ABOUT THE MOON IN TERMS OF A SPECIALIZED POTENTIAL

By Edward J. Kenyon,
William A. Sullivan,
and William A. Reini,
Orbital Mission Analysis Branch

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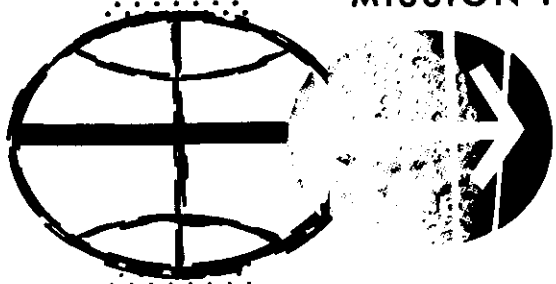

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January 18, 1968

PREFLIGHT DATA FOR A LUNAR LANDING MISSION

VOLUME III- TRAJECTORY PARAMETER SUMMARIES FOR EACH LAUNCH DAY IN THE MONTHLY WINDOW

By Lunar Mission Design Section,

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-17

JANUARY 18, 1968

NAVIGATIONAL CAPABILITIES OF THE SEXTANT AND RANGING DEVICE FOR CSM-ACTIVE RENDEZVOUS

By Jack H. Shreffler,
Mathematical Physics Branch

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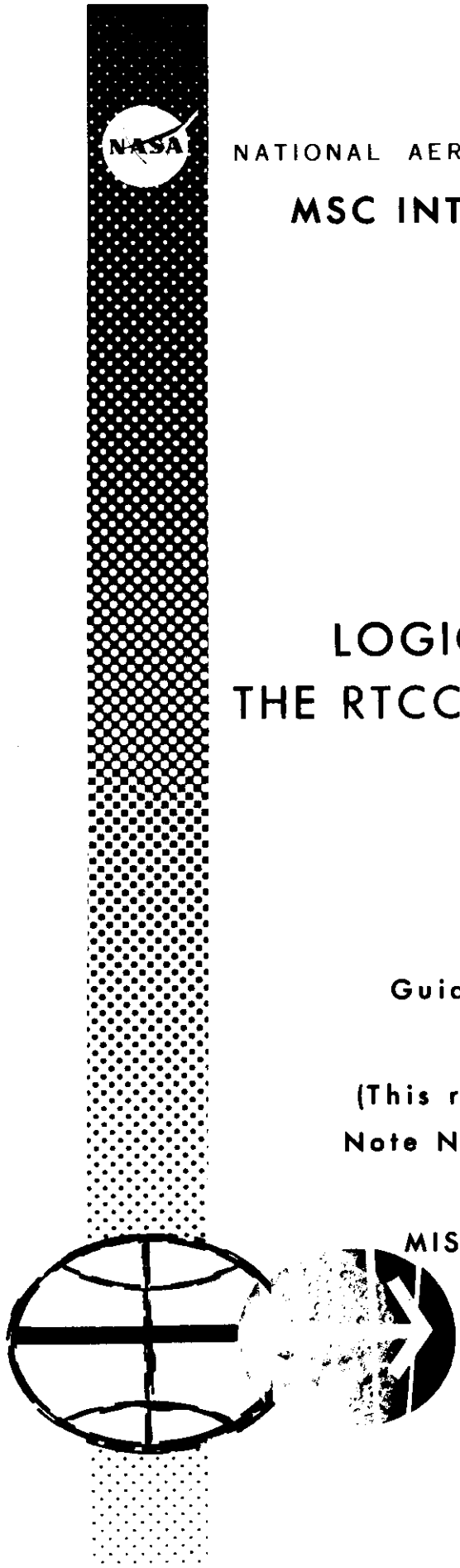

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MSC INTERNAL NOTE NO. 68-FM-18

January 22, 1968

LOGIC AND EQUATIONS FOR THE RTCC LUNAR ASCENT PREDICTOR

By Don R. Beggs

and

Moises N. Montez,

Guidance And Performance Branch

(This revision supersedes MSC Internal Note No. 67-FM-70 dated May 19, 1967.)

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MSC INTERNAL NOTE NO. 68-FM-19

January 22,1968

MPAD VERIFICATION OF APOLLO 5 (AS-204/LM-1) FLIGHT MISSION RULES

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By Mission Planning And Analysis Division

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MSC INTERNAL NOTE NO. 68-FM-20

January 22, 1968

STATUS REPORT ON THE LUNAR MISSION ENTRY MONITORING AND BACKUP MODE DEVELOPMENT

By Jon C. Harpold

and

James C. Adams,

Lunar Mission Analysis Branch

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FA-MGPSS
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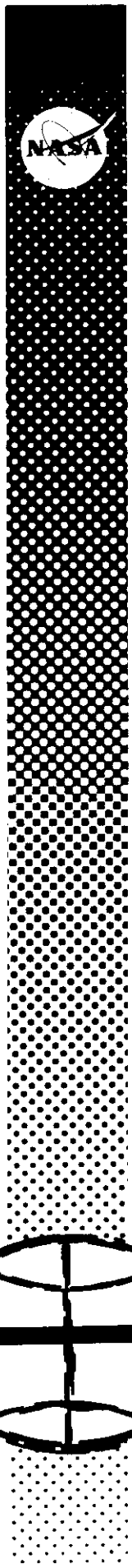

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MSC INTERNAL NOTE NO. 68-FM-23

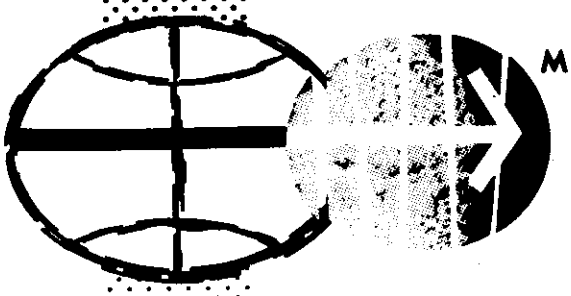
January 26, 1968

LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF THE LUNAR MODULE DESCENT PLANNING TABLE

By William A. Sullivan

Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-68 dated May 9, 1967)



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MSC INTERNAL NOTE NO. 68-FM-24

January 30,1968

MINIMUM VELOCITY INCREMENT SINGLE-IMPULSE PROPULSIVE-GRAVITY TURN WITH CONSTRAINTS ON THE PERIAPSIS RADIUS

By Benjamine J. Garland,

Advanced Mission Design Branch

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MSC INTERNAL NOTE NO. 68-FM-26

January 30, 1968

APOLLO MISSION C REQUIREMENTS FOR THE REAL-TIME PROGRAM REENTRY PHASE

By James W. Tolin, Jr.
and Oliver Hill,
Lunar Mission Analysis Branch

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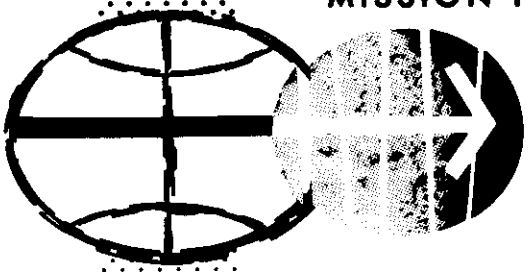

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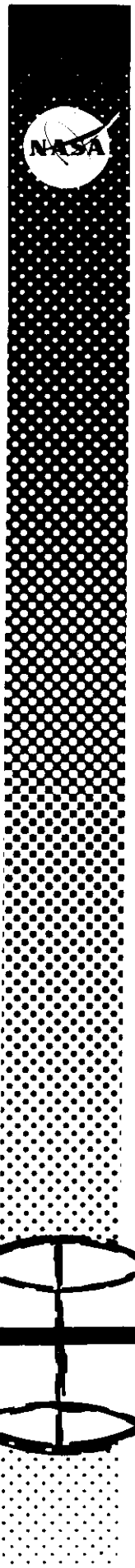

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MSC INTERNAL NOTE NO. 68-FM-27

February 1, 1968

RTCC REQUIREMENTS FOR MISSION G: RETURN-TO-EARTH ABORT CONIC SUBPROCESSOR FOR MOON-CENTERED ABORTS

By D. M. Gafford,

F. M. Northcutt,

and J. D. Monroe,

TRW Systems

(This document supersedes MSC Internal Note No. 67-FM-80 dated June 19, 1967.)

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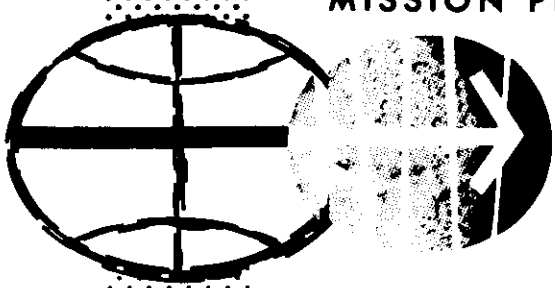

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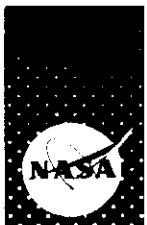

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MSC INTERNAL NOTE NO. 68-FM-28

February 1, 1968

RTCC REQUIREMENTS FOR MISSIONS E AND G: TRANSLUNAR INJECTION PROCESSOR

By David S. Scheffman,
Jerome D. Yencharis,
and Brody O. Mc Caffety,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-90 dated June 29, 1967.)

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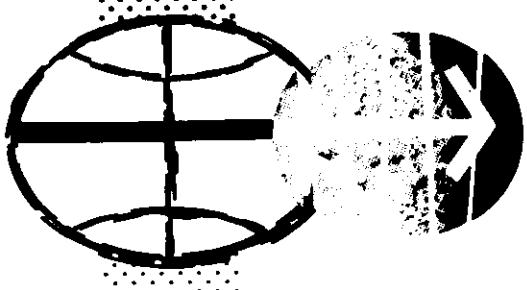

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MSC INTERNAL NOTE NO. 68-FM-30

February 1, 1968

RTCC REQUIREMENTS FOR MISSION G: SELECTING AND VERIFYING USBS DOPPLER DATA SOURCES DURING LM ASCENT AND DESCENT

By Alan D. Wylie,

Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 67-FM-137 dated September 26, 1967.)

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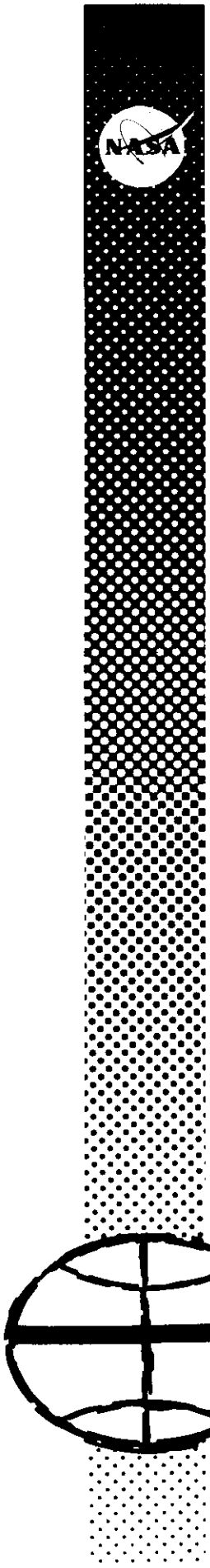

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MSC INTERNAL NOTE NO. 68-FM-2

February 1, 1968

RTCC REQUIREMENTS FOR MISSION G: LANDING SITE DETERMINATION USING ONBOARD OBSERVATIONS

By Paul F. Flanagan,
Mathematical Physics Branch,
and George A. Austin,
Analytical Mechanics Associates, Inc.

(This document supersedes pp. 103-120 and pp. 223-236 of MSC Internal Note No. 67-FM-51 dated May 31, 1967.)

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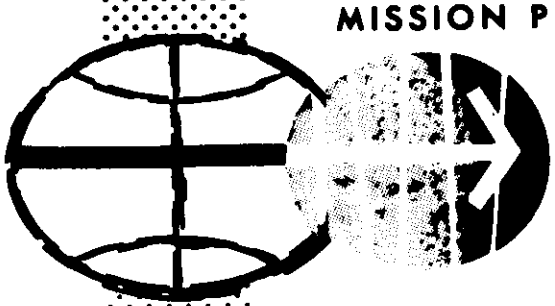

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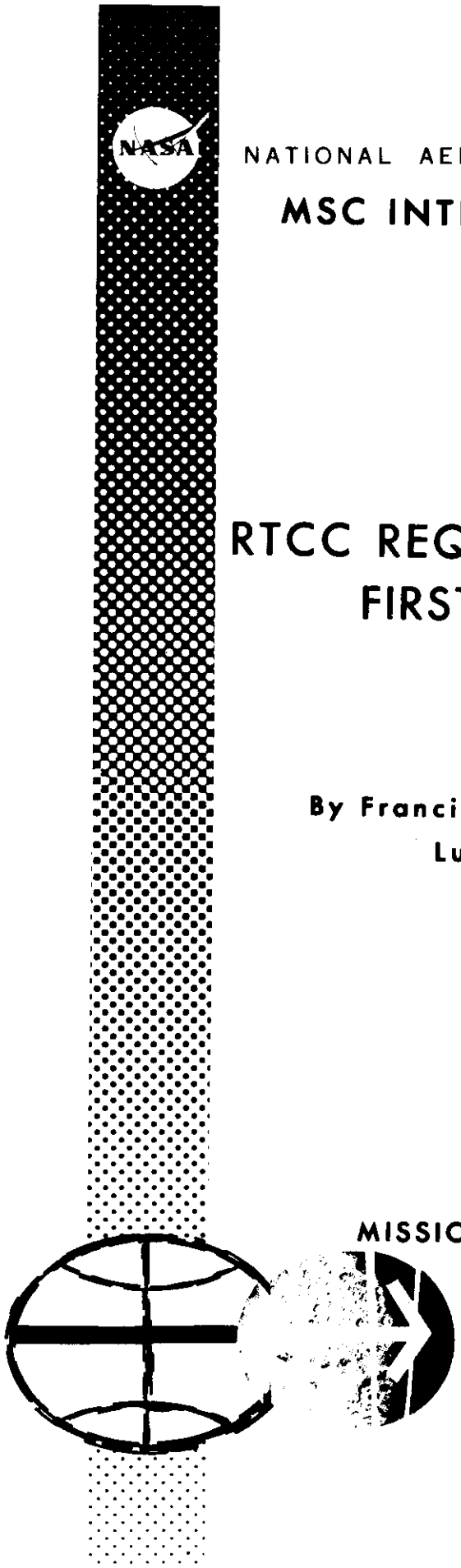

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MSC INTERNAL NOTE NO. 68-FM-32

February 26, 1968

RTCC REQUIREMENTS FOR MISSION G: FIRST-GUESS LOGIC FOR THE TLI PROCESSOR

By Francis Johnson, Jr. and Thomas J. Linbeck
Lunar Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-33

February 1, 1968

RTCC REQUIREMENTS FOR MISSIONS E AND G: THE RETURN-TO-EARTH ABORT PROCESSOR VOLUME II - MOON-CENTERED LOGIC

By Robert S. Davis,

Lunar Mission Analysis Branch,

and D. W. Gafford,

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(This document supersedes MSC Internal Note No. 67-FM-199 dated December 15, 1967.)

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MSC INTERNAL NOTE NO. 68-FM-34

February 1, 1968

RTCC REQUIREMENTS FOR MISSION G: LOI TARGETING PROCESSOR

By Robert F. Wiley,

Lunar Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-35

February 9, 1968

LOGIC FOR REAL-TIME COMPUTATION OF LUNAR CONCENTRIC RENDEZVOUS MANEUVERS

By Elric N. McHenry,
Orbital Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-20 dated January 31, 1967.)

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MSC INTERNAL NOTE NO. 68-FM-36

February 14, 1968

REENTRY ERROR ANALYSIS FOR THE APOLLO LUNAR LANDING MISSION

By Claude A. Graves,

Lunar Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-38

February 14, 1968

PREFLIGHT TRACKING DATA FOR THE LAUNCH PHASE OF A LUNAR MISSION

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PA-AstMgr
PA-A,MgFLS
PA-TecAst
PA2
PD ✓
PE
PF
PP
PR
PT
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PD- Eckert ✓
PD7- Lattery ✓

By Edward M. Jiongo,

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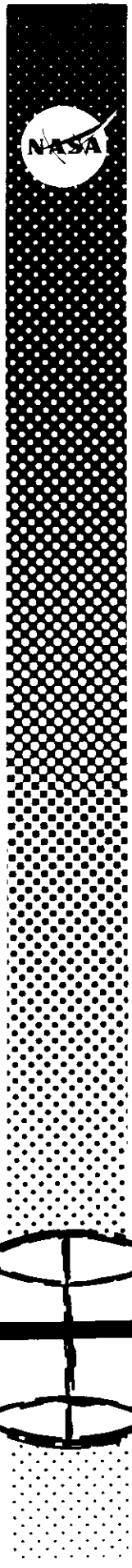

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MSC INTERNAL NOTE NO. 68-FM-42

February 16,1968

PRELIMINARY STUDY OF POLAR LUNAR LANDING MISSIONS DURING 1971

By John T. McNeely,

Advanced Mission Design Branch

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MSC INTERNAL NOTE NO. 68-FM-44

February 16, 1968

DOPPLER OBSERVABLE MODELING FOR THE APOLLO REAL-TIME ORBIT DETERMINATION PROGRAM

By Howard G. de Vezin,
Mathematical Physics Branch

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PA-M,LM —
PA-AstMgr —
PA-A,MgFLS —
PA TecAst —
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MSC INTERNAL NOTE NO. 68-FM-54

February 27, 1968

PRELIMINARY ANALYSIS OF MONITORING AN IGM-STEERED, HYPERSURFACE-TARGETED TLI MANEUVER USING CMC LAMBERT STEERING AND THE SATURN-PREFERRED IMU ALIGNMENT

By Robert F. Wiley,
Lunar Mission Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-57

March 29, 1968

MSC/MSFC LUNAR MISSION TARGETING EXERCISE

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PA-M,CSM
PA-M,LM
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PA-Ops
PA2
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12-Adams ✓
PD7-Bastley ✓

By Lunar Mission Design Section,
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MSC INTERNAL NOTE NO. 68-FM-31

February 29, 1968

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY LV-502/CSM-020 FLIGHT ANNEX

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By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
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MSC Subtask Monitor
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MSC INTERNAL NOTE NO. 68-FM-60

MARCH 1, 1968

RTCC REQUIREMENTS FOR MISSION G: THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

By Bernard F. Morrey and Brody O. McCaffety,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-80 dated June 19, 1967.)

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MSC INTERNAL NOTE NO. 68-FM-62

March 13, 1968

APOLLO 6 (A-2 OR AS-502/CSM-020) SPACECRAFT OPERATIONAL TRAJECTORY VOLUME I - MISSION PROFILE

By William J. Bennett and Ronny H. Moore,
Orbital Mission Analysis Branch,
and Jon C. Harpold,
Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-66

March 11, 1968

RTCC REQUIREMENTS FOR MISSIONS E, F, AND G: PREFLIGHT INFORMATION

By Rocky D. Duncan,
Lunar Mission Analysis Branch

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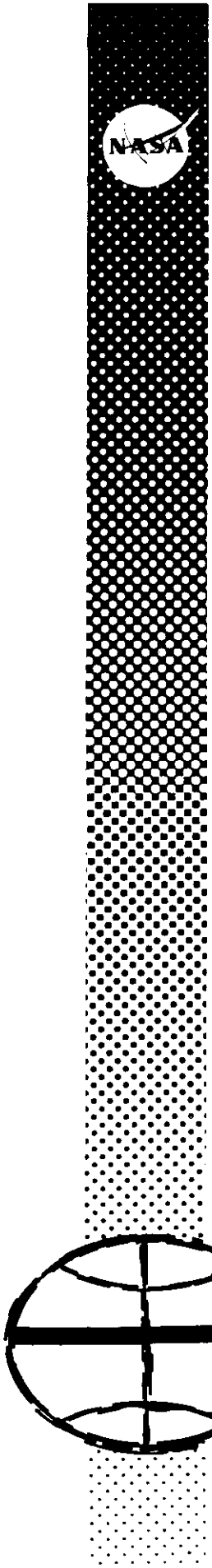

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-67

March 8, 1968

LOGIC AND EQUATIONS FOR THE REAL-TIME COMPUTATION OF THE LM LAUNCH TARGETING AND DISPLAY

By Jerome W. Kahanek,
Orbital Mission Analysis Branch

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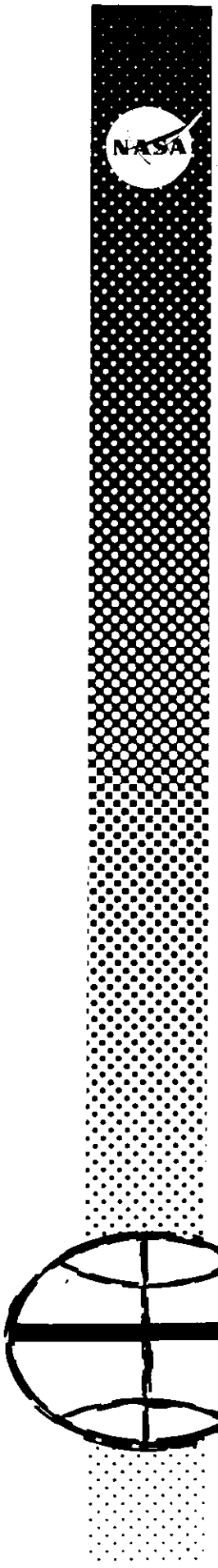

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-68

March 8, 1968

RTCC REQUIREMENTS FOR MISSION G: SELECTING AND VERIFYING USBS DOPPLER DATA SOURCES DURING LM ASCENT AND DESCENT

By Alan D. Wylie,
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-30 dated February 1, 1968.)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-69

March 14, 1968

RTCC REQUIREMENTS FOR MISSIONS F AND G: EARTH ORBIT INSERTION PROCESSOR

By Edward M. Jiongo,
Lunar Mission Analysis Branch

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PA/G M. Low

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-70

April 1, 1968

MANNED EXPLORATION OF MARS: A MINIMUM-ENERGY MISSION PLAN FOR MAXIMUM SCIENTIFIC RETURN

By Jack Funk, James J. Taylor,

Joseph R. Thibodeau III,

Flora B. Lowes, and John T. McNeely,

Advanced Mission Design Branch

PD-Cohen
PD-Gathings
PD12-Ward

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-72

March 27, 1968

APOLLO MISSION E(AS-504/CSM-104/ LM-4) SPACECRAFT REFERENCE TRAJECTORY VOLUME I - MISSION PROFILE

By David D. DeAtkine and Alexander Woronow,
Orbital Mission Analysis Branch,
and Oliver Hill and Joseph E. Rogers,
Lunar Mission Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-73

March 22, 1968

COMPARISON OF LM PGNCS AND AGS ORBIT INSERTION GUIDANCE LOGIC AND PROCEDURES

By Joe D. Payne,

Lunar Landing Branch

PA-M,CSM
PA-M,LM
PA-A,MgFLS
PA-Tech St
PA2
PD
PE
PF
PP
PT
FILES
NA

PD - Colvin
- Bailey
- Ward

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PA/G.M. Low

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-74

March 20, 1968

LM POWERED ASCENT TRAJECTORY FOR THE APOLLO LUNAR LANDING MISSION

By Joe D. Payne, William C. Lamey,

and Burl G. Kirkland,

Lunar Landing Branch

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05952-H401-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-77

March 8, 1968

LAUNCH PHASE ABORT ANALYSIS FOR A 50-DEGREE ORBITAL INCLINATION TRAJECTORY

PA-MGR ✓
PA- —
PF- —
P- —
F- ✓
F —
F —
FP —
PT —
FILES —
NA —
PD — Cashion
PD — Sutton
PD-2 — Ward

By Spaceflight Operations Department
TRW Systems Group

MSC Task Monitor
B. D. Weber

MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-80

March 26, 1968

GENERAL EXPLANATIONS OF NCC/NSR AND CSI/CDH COELLIPTIC SEQUENCE RENDEZVOUS TECHNIQUES

By James D. Alexander,
Orbital Mission Analysis Branch

FA-MGR ✓
FA-M,CSM
FA-LEM
FA-FLS
FA-SR
FA
FC ✓
FC
FF
FP
PT
FILES
NA
FC - Cohen
FC - Salley
1512 - Ward

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-82

March 29, 1968

COMPARISON OF VENUS SWINGBY AND MINIMUM-ENERGY TECHNIQUES FOR MANNED MARS ORBITING MISSIONS

PA-MGR ✓
PA-M,CSM
PA-M,LM
PA-A,MgFLS
PA-TecAst
PA2
PD ✓
PL
PF
PP
PT
FILES
NA

By James J. Taylor,

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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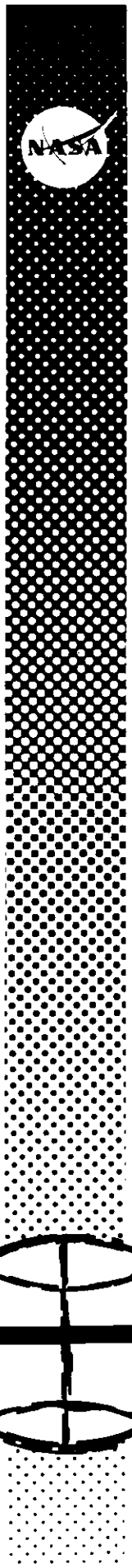

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-83

March 29, 1968

COMPARISON OF THE SENSITIVITY OF LAMBERT AND EXTERNAL ΔV GUIDANCES TO DISPERSIONS IN THE LOI BURNS OF MISSIONS F AND G

By Robert F. Wiley,

Lunar Mission Analysis Branch

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PA/G.N. Low

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-84

APRIL 21, 1968

FEASIBILITY OF MANUAL COMPLETION OF A LOI BURN VOLUME II- BMAG DRIFT ABOUT THE PITCH AXIS

By Alexander H. Treadway
Flight Analysis Branch

PA-MGR ✓
PA-M,CSM
PA-M,LM
PA-A,MgFLS
PA-TecAst
PA2
PD ✓
PE
PF
PP
PT ✓
FILES
NA

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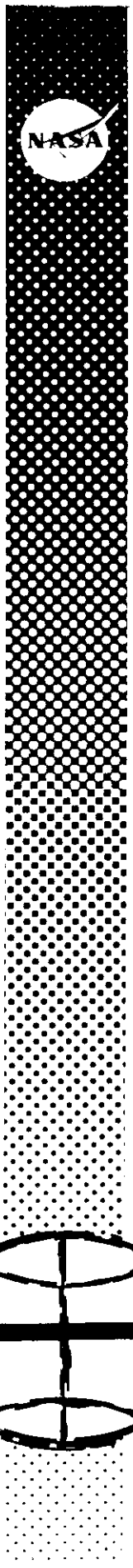

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-85

April 3, 1968

RTCC REQUIREMENTS FOR THE TLI BURN GO - NO-GO PROCEDURE

By Herbert S. Estes,

Guidance and Performance Branch

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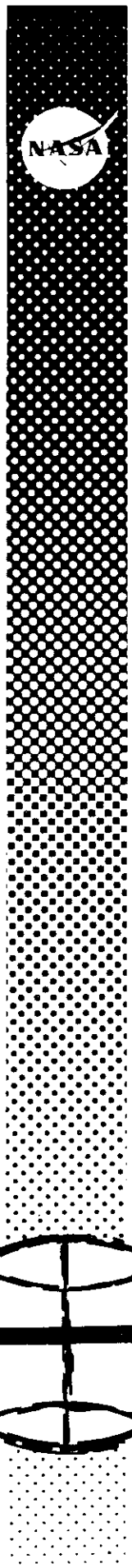


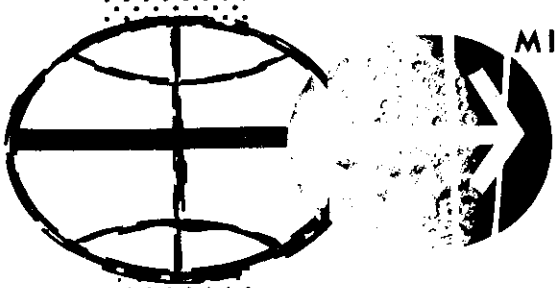
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-86

April 10, 1968

RADAR DATA FOR CHOOSING PASSES TO SATISFY THE MISSION C (AS-205/CSM-101) RENDEZVOUS RADAR TEST OBJECTIVE

By Samuel L. Miller and David J. Griffith,
Orbital Mission Analysis Branch



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-87

April 3, 1968

MPAD VERIFICATION OF APOLLO 6 (A-2/CSM-020) FLIGHT MISSION RULES

By Mission Planning And Analysis Division

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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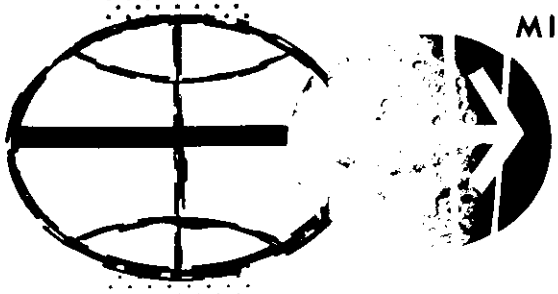
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE NO. 68-FM-88

April 12, 1968

IMPULSIVE ORBIT TRANSFER OPTIMIZATION BY AN ACCELERATED GRADIENT METHOD

By Ivan L. Johnson, Jr.,
Mathematical Physics Branch



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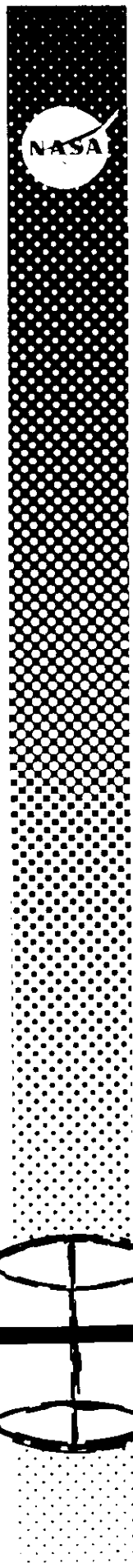


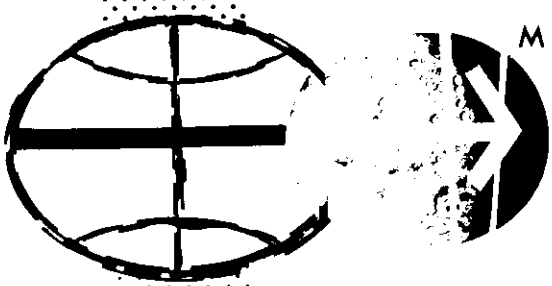
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-89

April 8, 1968

THE ACCURACY OF SUBROUTINE CIST

By Francis Johnson, Jr.,
Lunar Mission Analysis Branch



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM- 58

February 26, 1968

APOLLO 6 (A-2 OR AS-502/020) OPERATIONAL SPACECRAFT ABORT PLAN

By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
TRW Systems Group

MSC Task Monitor
A. N. Lunde

MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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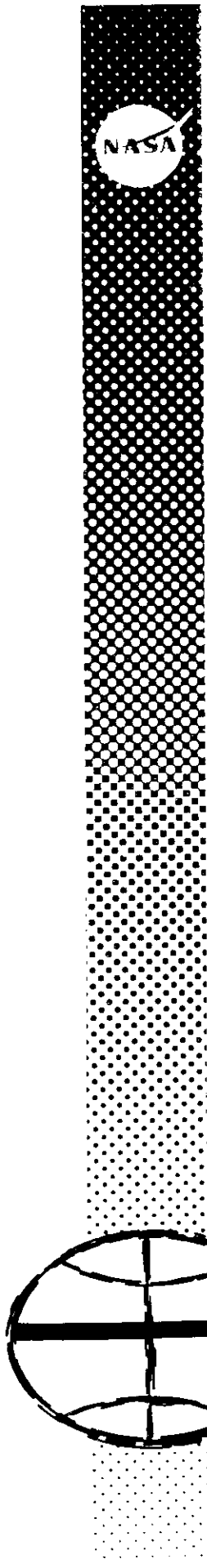

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-91

May 27, 1968

VERIFICATION OF THE KALMAN FILTER EQUATIONS USED IN THE LM AGS

By Richard E. Eckelkamp and Troy J. Blucker,
Mathematical Physics Branch,
and
Samuel Pines,
Analytical Mechanics Associates, Inc.

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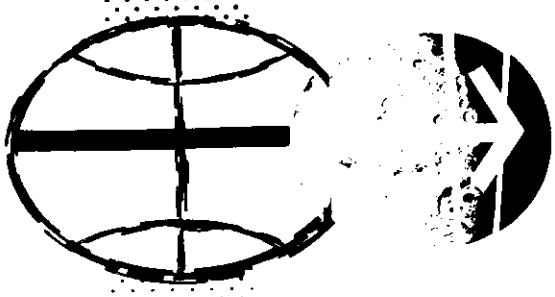

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-92

July 3, 1967

ORBITAL ELEMENTS FOLLOWING PREMATURE TRANSLUNAR INJECTION SHUTDOWNS

By Charles E. Foggatt

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-95

April 17, 1968

COMPATIBILITY OF LM PGNCS AND AGS RENDEZVOUS MANEUVER COMPUTATIONS

By Dennis M. Braley, Ernest M. Fridge,

Robert N. Hinson, and Elric N. McHenry,

Orbital Mission Analysis Branch

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1968

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-97

April 18, 1968

COMMUNICATION BLACKOUT REGIONS FOR APOLLO LUNAR MISSION REENTRIES

By John Burton and Nicholas W. Kirincich,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 66-FM-142 dated November 25, 1966.)

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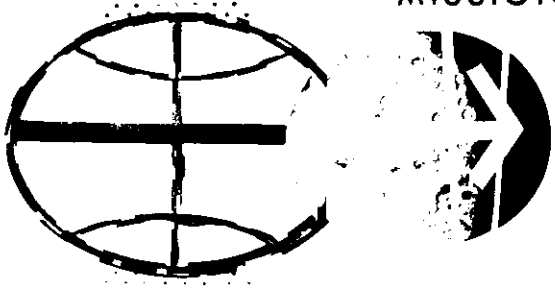

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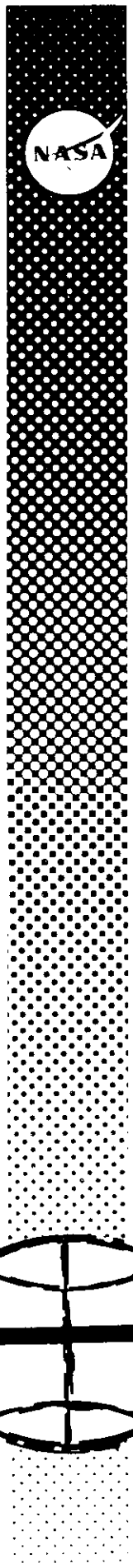


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-98

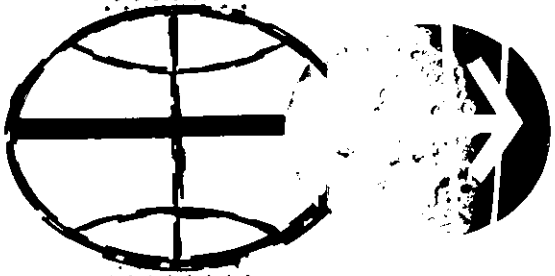
April 19, 1968

RTCC REQUIREMENTS FOR MISSIONS F AND G: SELENOGRAPHIC-MNBY VELOCITY TRANSFORMATION FORMULATION

By Paul F. Flanagan,

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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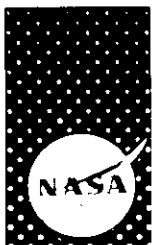


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-99

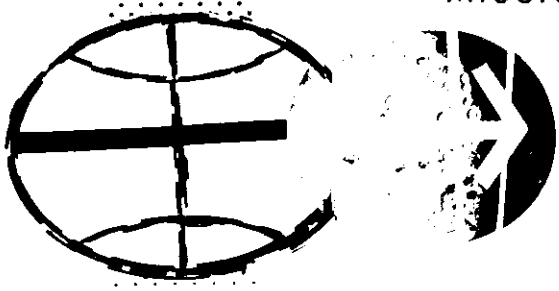
April 19, 1968

POSTFLIGHT SIMULATION OF THE APOLLO 5 TRAJECTORY FROM THE SECOND DPS BURN TO TOUCHDOWN

By Veit Hanssen,

Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-100

PROJECT APOLLO

BASIC EQUATIONS AND LOGIC FOR THE REAL-TIME GROUND NAVIGATION PROGRAM FOR THE APOLLO LUNAR LANDING MISSION

By Emil R. Schiesser, Howard G. deVezin,
Robert T. Savely, and Michael J. Oles
Mathematical Physics Branch

April 15, 1968

MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Approved: _____
James C. McPherson, Chief
Mathematical Physics Branch

Approved: _____
John P. Mayer, Chief
Mission Planning and Analysis Division

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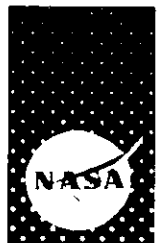

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-102

APRIL 24, 1968

RTCC REQUIREMENTS FOR MISSIONS D, E AND F: REENTRY PHASE

By James W. Tolin, Jr., Grover D. Fulkerson,
Jon C. Harpold, James C. Adams,
and Joseph E. Rogers,
Lunar Mission Analysis Branch

(This revision supersedes MSC Internal Note No. 67-FM-198 dated December 15, 1967.)

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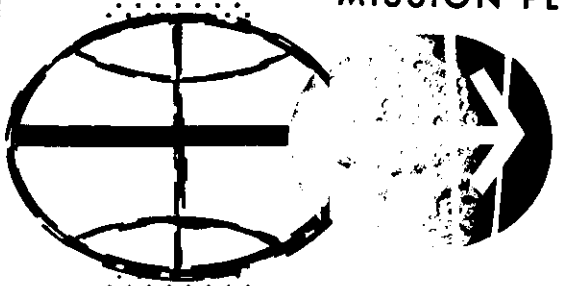

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-104

April 29, 1968

LAUNCH ABORT PHILOSOPHY FOR MANNED SPACE FLIGHTS

By Charles T. Hyle,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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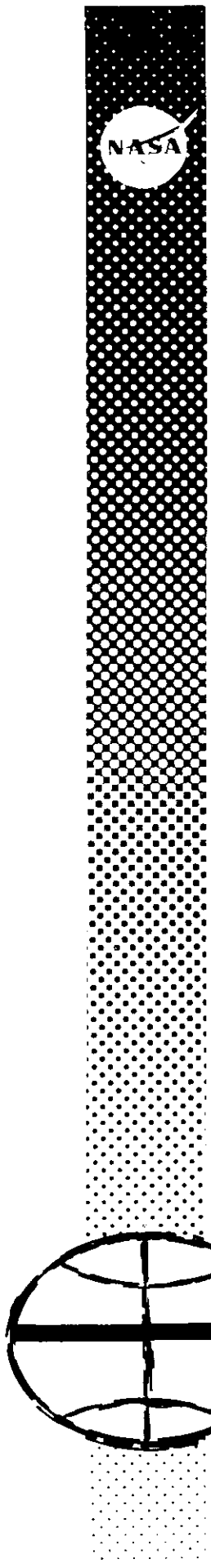


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

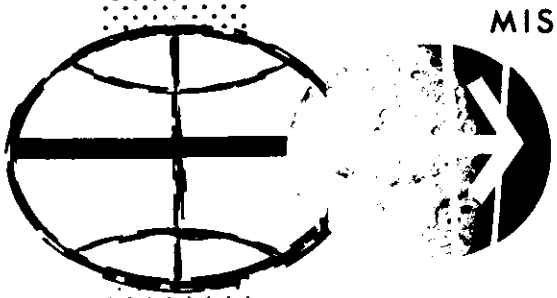
MSC INTERNAL NOTE NO. 68-FM-105

April 30, 1968

RTCC REQUIREMENTS FOR MISSION G: SELECTING AND VERIFYING USBS DOPPLER DATA SOURCES DURING LM ASCENT AND DESCENT

By Alan D. Wylie,
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-68 dated March 8, 1968.)



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-106

May 1, 1968

APOLLO CSM AND LM ONBOARD NAVIGATION SYSTEM CONSTRAINTS

By T. J. Blucker,
Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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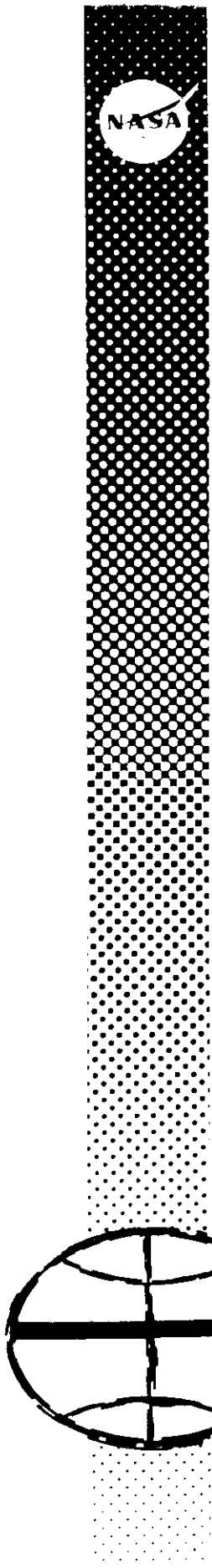


NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-107

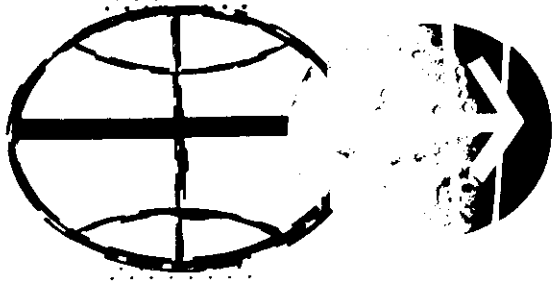
May 1, 1968

RTCC REQUIREMENTS FOR MISSION D AND SUBSEQUENT MISSIONS: LOGIC FOR THE MISSION PLANNING TABLE

By Ernest M. Fridge,

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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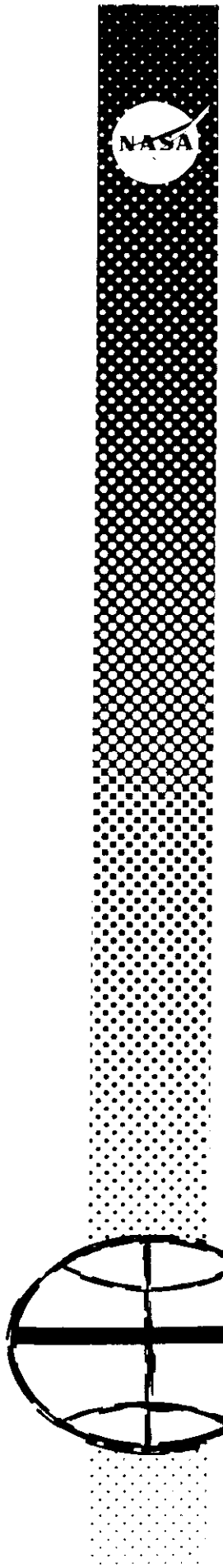

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-109

May 6, 1968

MISSION G ELECTRICAL POWER SUBSYSTEM AND ENVIRONMENTAL CONTROL SUBSYSTEM CONSUMABLES ANALYSIS AS DEFINED FOR CONFIGURATION CONTROL

By Martin L. Alexander, Richard C. Wadle,

Harry Kolkhorst, Richard M. Swalin,

and Roy E. Stokes,

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-113

May 9, 1968

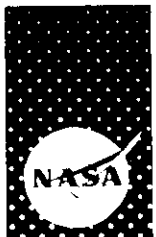
THE EFFECTS OF IU PLATFORM PITCH DRIFT RATES ON TLI FOR THE LUNAR LANDING MISSION

By Alexander Treadway,
Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-17



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

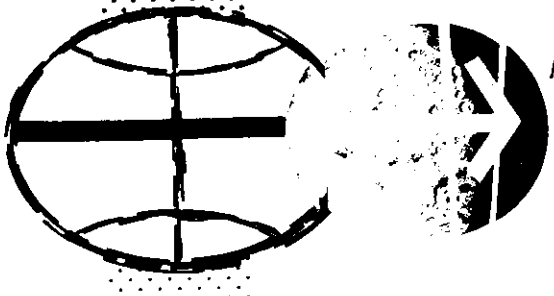
MSC INTERNAL NOTE NO. 68-FM-114

April 18, 1968

C-MISSION (205/101) NAVIGATION ERROR ANALYSIS

By Navigation Analysis Section
TRW Systems Group

MSC Task Monitor
P. Mitchell



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE NO.68-FM-115

May 13,1968

ANALYTIC EPHEMERIS GENERATION

By Edward J. Kenyon,
Orbital Mission Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-116

May 15, 1968

PRELIMINARY ABORT ΔV REQUIREMENTS FOR A COPERNICUS MISSION

By James C. Kirkpatrick,
Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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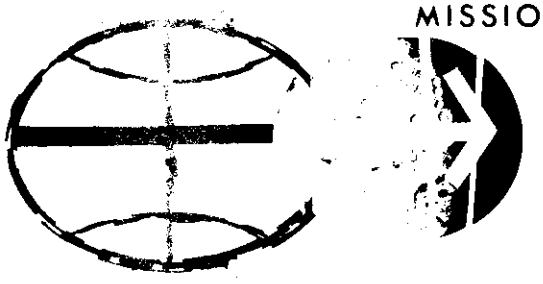
MSC INTERNAL NOTE NO. 68-FM-117

MAY 15, 1968

RTCC REQUIREMENTS FOR MISSIONS F AND G: SELENOGRAPHIC-MNBY VELOCITY TRANSFORMATION FORMULATION

By Paul F. Flanagan,
Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-98 dated April 19, 1968.)



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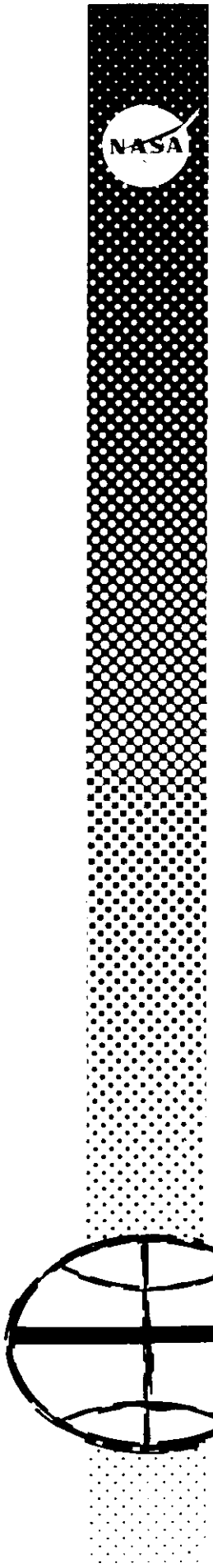

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MSC INTERNAL NOTE NO. 68-FM-119

May 21, 1968

LOGIC FOR THE EARTH ORBITAL AEG IN THE APOLLO REAL-TIME RENDEZVOUS SUPPORT PROGRAM

By Edward J. Kenyon,

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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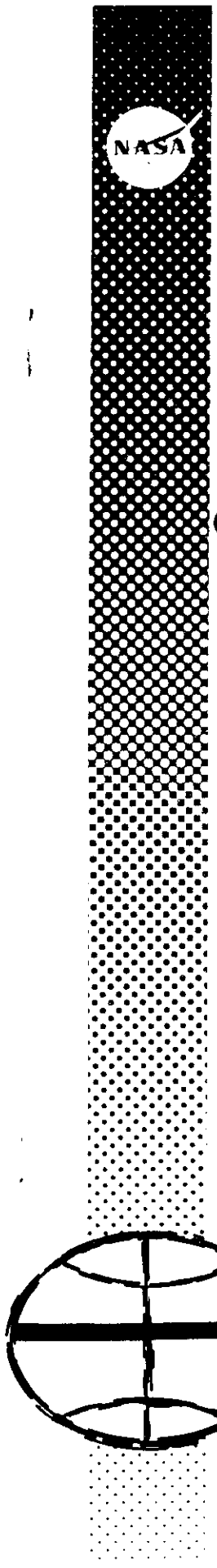

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MSC INTERNAL NOTE NO. 68-FM-120

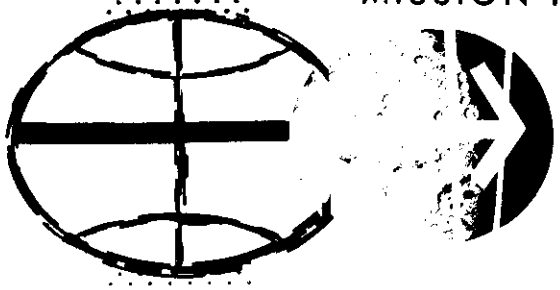
May 21, 1968

CSM-ACTIVE RENDEZVOUS SIMULATION STUDIES USING SEXTANT AND RANGING DEVICE

By B. F. Cockrell,

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION



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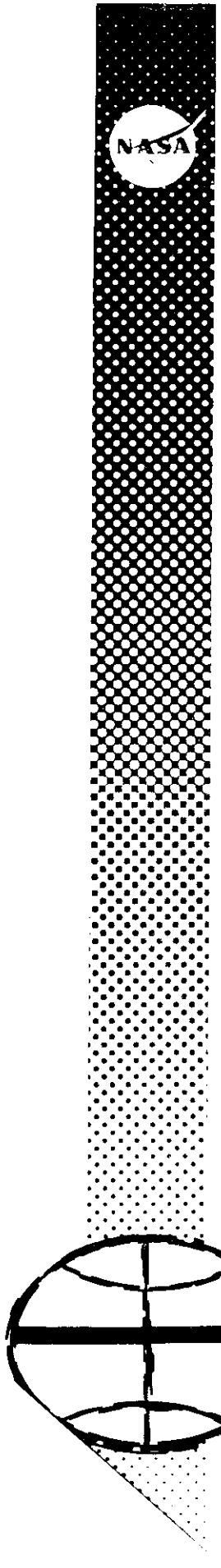

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-122

May 23, 1968

PRELIMINARY CONTINGENCY PROCEDURES FOR THE TRANSLUNAR INJECTION MANEUVER

By Bobbie D. Weber,

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 68-FM-123

MAY 27, 1968

REAL-TIME AUXILIARY COMPUTING FACILITY A-2/CSM-020 MISSION REPORT

By S.D. Holzaepfel
Flight Analysis Branch
and
P.A. DiValerio
D.C. McDougall
Mission Operations Section
TRW Systems Group

MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-125

MAY 28, 1968

RTCC REQUIREMENTS FOR MISSION G: LUNAR MODULE ATTITUDE DETERMINATION USING ONBOARD OBSERVATION

By B.F. Cockrell

Mathematical Physics Branch

(This revision supersedes MSC Internal Note No. 68-FM-52 dated February 23, 1968.)

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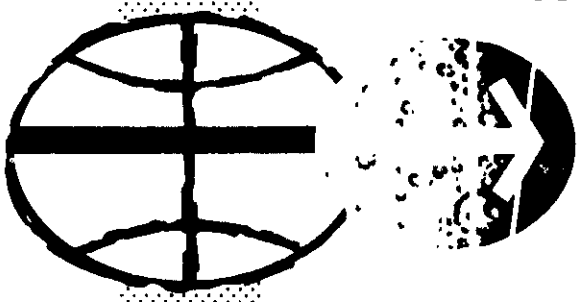

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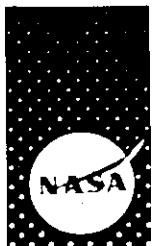

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-90

March 27, 1968

REENTRY POSTFLIGHT TRAJECTORY RECONSTRUCTION AND GUIDANCE EVALUATION FOR AS-501 (CSM-017)

By Flight Analysis Section,
TRW Systems

MSC Task Monitor
Jon Harpold

MISSION PLANNING AND ANALYSIS DIVISION

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P/A / G M Low

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-128

June 4, 1968

PRELIMINARY DISPERSION ANALYSIS OF FIVE RENDEZVOUS PROFILES FOR AAP MISSION AAP-1/AAP-2

By Larry Hartley,

Orbital Mission Analysis Branch

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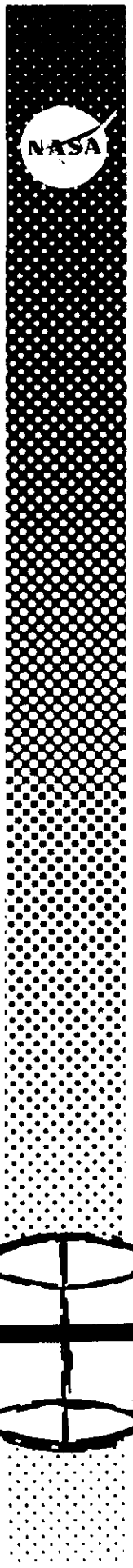

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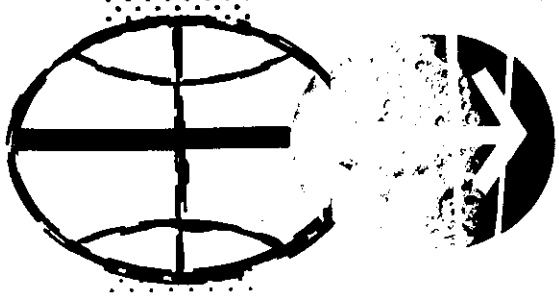
MSC INTERNAL NOTE NO. 68-FM-129

June 4, 1968

MATHEMATICAL MODEL FOR THE LM LUNAR ASCENT HYBRID SIMULATION

By James V. West,

Lunar Landing Branch



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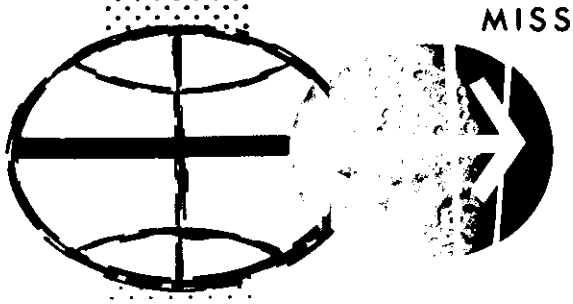
MSC INTERNAL NOTE NO. 68-FM-130

June 5, 1968

FACTORS INFLUENCING THE GUIDANCE ACCURACY OF A PLANETARY PROBE

By Thomas B. Murtagh,
Advanced Mission Design Branch



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MSC INTERNAL NOTE NO. 68-FM-140

June 12, 1968

MISSION G REQUIREMENTS FOR THE RTCC: NOMINAL ASCENT AND ABORT FROM DESCENT

By Veit Hanssen,
Lunar Landing Branch

(This document supersedes MSC Internal Note No. 67-FM-82 dated June 28, 1967)

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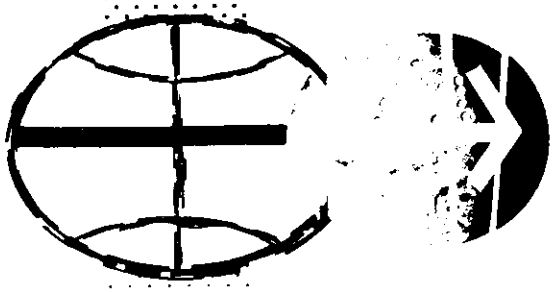

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MSC INTERNAL NOTE NO. 68-FM-143

June 14, 1968

POWERED LUNAR ASCENT PERFORMANCE CHARACTERISTICS

By Billy G. Taylor,

Lunar Landing Branch

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MSC INTERNAL NOTE NO. 68-FM-151

JUNE 21, 1968

RTCC REQUIREMENTS FOR MISSION G: THE TRANSLUNAR MIDCOURSE CORRECTION PROCESSOR

By Bernard F. Morrey, Brody O. McCaffety, and Alfred E. Morrey
Lunar Mission Analysis Branch

(The revision supersedes MSC Internal Note No. 68-FM-60 dated March 1, 1968)

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MSC INTERNAL NOTE NO. 68-FM-205

August 16, 1968

A SCHEME FOR IMPROVING THE LM LANDING RADAR ALTITUDE UPDATING OF THE PGNCS

By William F. Haldeman,
Lunar Landing Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-263

October 22, 1968

LM DESCENT AND ASCENT ΔV BUDGETS FOR THE LUNAR LANDING MISSION (APOLLO MISSION G)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 68-FM-314 DATED DECEMBER 31, 1968

LOGIC AND EQUATIONS FOR RTCC COMPUTATION

OF LUNAR LANDING DESCENT TRAJECTORY

By Edwin G. Dupnick

Change 2

Revised by Richard J. Labrecque

May 23, 1969

Floyd V. Bennett, Chief
Landing Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

After the attached enclosures, which are replacements, have been inserted and after the following pen-and-ink changes has been made, place this CHANGE SHEET between the cover and title page and write on the cover, "CHANGE 2 inserted".

1. Replace pages 15, 16, 17, 18, 19, 20, 23, 24, and 25.

2. Delete reference to engine pulse-out inhibit and linear guidance on pages 2 and 3.

3. Change start of vertical descent phase from 75 feet to 150 feet.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

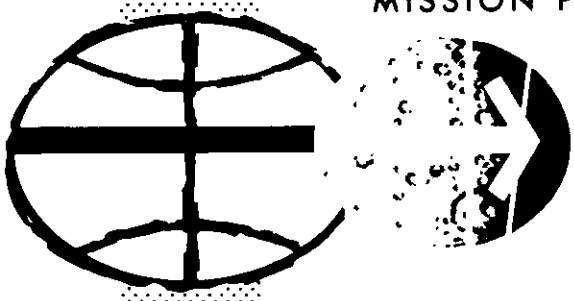
MSC INTERNAL NOTE NO. 68-FM-270

November 4, 1968

A DESCRIPTION OF THE OUTPUT AND DISPLAYS OF THE APOLLO MISSION PLANNING AND REAL-TIME RENDEZVOUS SUPPORT PROGRAM

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-274

November 14, 1968

ABORT RESET POINTS FOR AN APOLLO 8 MISSION LAUNCHED DECEMBER 21, 1968

Flight Analysis Branch

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MSC INTERNAL NOTE NO. 68-FM-275

November 14, 1968

EFFECTS OF LOCAL TERRAIN PROFILES ON THE NOMINAL LM DESCENT TRAJECTORY

Landing Analysis Branch

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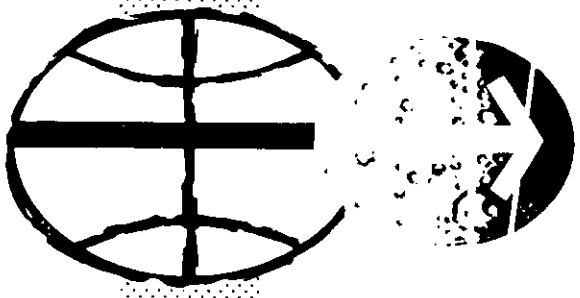

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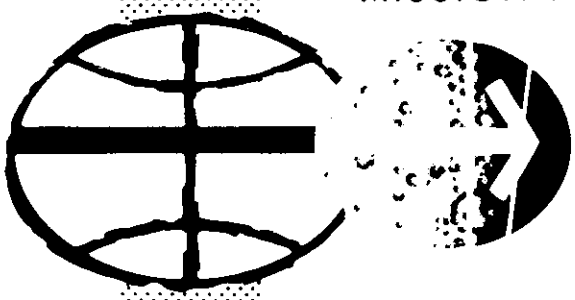
MSC INTERNAL NOTE NO. 68-FM-294

December 9, 1968

APOLLO 8 MANEUVER ATTITUDES RELATIVE TO THE CELESTIAL SPHERE AS VIEWED FROM THE SPACECRAFT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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MSC INTERNAL NOTE NO. 68-FM-307

December 16, 1968

THE EARTH AND THE MOON AS VIEWED FROM THE SPACECRAFT DURING THE APOLLO 8 MISSION

Flight Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-126

May 29, 1968

APOLLO MISSION E
(AS-504/CSM-104/LM-4)
SPACECRAFT REFERENCE TRAJECTORIES
VOLUME IV-CONSUMABLES ANALYSIS

By Arnold J. Loyd, Martin L. Alexander,
Richard C. Wadle, Harry Kolkhorst, Richard M. Sasso,
and Sam A. Kamen,
Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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APOLLO 4

ANOMALY REPORT NO. 12

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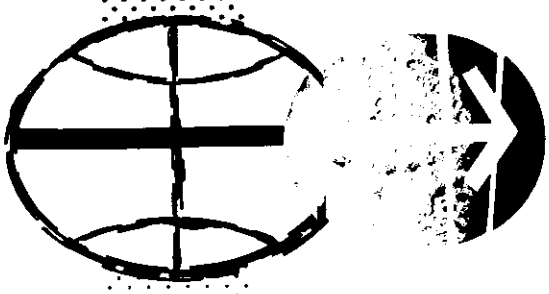
MSC INTERNAL NOTE NO. S-PA-8-T-011

MAY 17 , 1968

APOLLO MISSION TECHNIQUES
MISSION C (AS-205/CSM-101)
RETROFIRE AND REENTRY

VOLUME II

DATA ACCEPTANCE LIMITS
ANALYSIS PLANS



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MSC INTERNAL NOTE NO. S-PA-8T-016

MAY 29, 1968

APOLLO MISSION TECHNIQUES
MISSION C (AS-205/CSM - 101)
CSM RENDEZVOUS

VOLUME 1

TECHNIQUES DESCRIPTION

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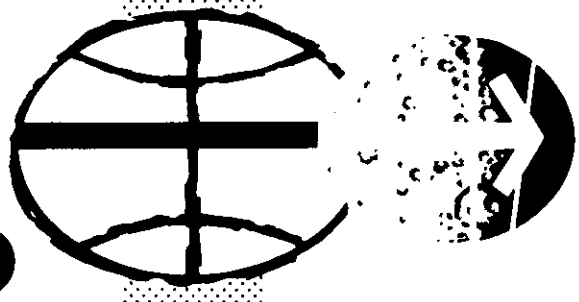
MSC INTERNAL NOTE NO. S-PA-8T-025

APOLLO MISSION TECHNIQUES
MISSION G
LUNAR SURFACE PHASE

TECHNIQUES DESCRIPTION

October 6, 1968



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MSC INTERNAL NOTE NO. S-PA-8T-026

October 22,1968

APOLLO MISSION TECHNIQUES
SATURN V/APOLLO
LAUNCH PHASE ABORTS

TECHNIQUES DESCRIPTION

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MSC INTERNAL NOTE NO. S-PA-8M-030

NOVEMBER 13, 1968

APOLLO MISSION TECHNIQUES
MISSION C-PRIME LUNAR (ALTERNATE 1)
TRANSLUNAR MIDCOURSE CORRECTIONS
AND
LUNAR ORBIT INSERTION

VOLUME 1
TECHNIQUES DESCRIPTION

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MSC INTERNAL NOTE NO. S-PA-8M-030

December 20, 1968

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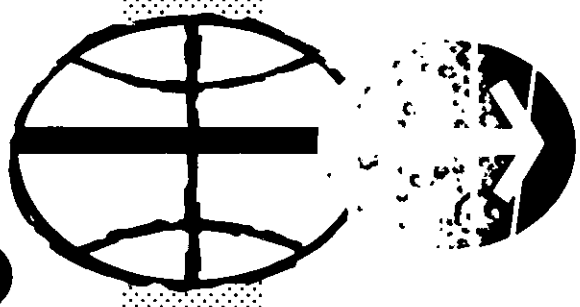
TRANSLUNAR MIDCOURSE CORRECTIONS
AND
LUNAR ORBIT INSERTION

VOLUME 1
TECHNIQUES DESCRIPTION

REVISION A



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8M-031

DECEMBER 16, 1968

APOLLO MISSION TECHNIQUES
C-PRIME LUNAR (ALTERNATE 1)
CONTINGENCY PROCEDURES
(REVISION A)

TECHNIQUES DESCRIPTION

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MSC INTERNAL NOTE NO. S-PA-8M-032

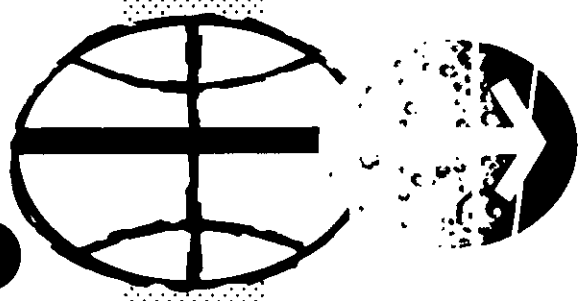
November 15, 1968

APOLLO MISSION TECHNIQUES

C-PRIME LUNAR (ALTERNATE 1)

LUNAR ORBIT ACTIVITIES

TECHNIQUES DESCRIPTION



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MSC INTERNAL NOTE NO. S-PA-8M-035

DECEMBER 16, 1968

APOLLO MISSION TECHNIQUES
EARTH PARKING ORBIT
RETROFIRE AND ENTRY PROCEDURES
(MISSIONS C PRIME, D, F, AND G)

VOLUME 1
TECHNIQUES DESCRIPTION

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NARA SW Box E209B-19

MSC-PT-R-68-1
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER INTERNAL TECHNICAL NOTE

APOLLO 4 MISSION

ANOMALY REPORT NO. 4

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January 1968

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE MSC-CF-D-69-18

APOLLO EGRESS TRAINING PLAN

REVISION B

PREPARED BY

MISSION TRAINING SECTION
MISSION OPERATIONS BRANCH
FLIGHT CREW SUPPORT DIVISION

MARCH 17, 1969

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MSC INTERNAL NOTE MSC-CF-D-69-19

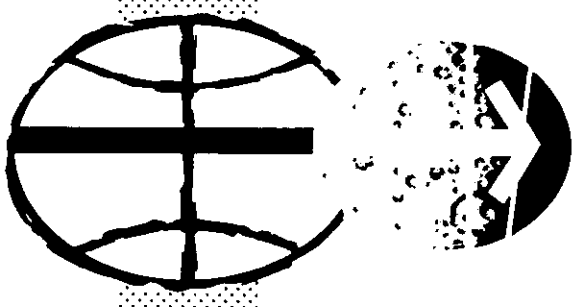
SPACECRAFT FIRE TRAINING PLAN FOR FLIGHT CREWS

THIS DOCUMENT SUPERCEDES MSC
INTERNAL NOTE NO. MSC-CF-D-67-14

MAY 1, 1969

PREPARED BY

MISSION TRAINING SECTION
MISSION OPERATIONS BRANCH
FLIGHT CREW SUPPORT DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE MSC-CF-D-69-20

PHOTOGRAPHIC TRAINING PLAN

MISSION H-1

MAY 1, 1969

PREPARED BY
EXPERIMENTS SECTION
MISSION OPERATIONS BRANCH
FLIGHT CREW SUPPORT DIVISION

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MSC FORM 2026A (REV MAY 68)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC-CF-P-69-22

MANUAL BOOSTER CONTROL

DISPERSION ANALYSIS

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

May 6, 1969

NARA SW Box E209B-20

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE MSC-CF-P-69-30

APOLLO ABORT SUMMARY DOCUMENT

MISSION G & SUBS (AS-506/107)

FINAL

MAY 21, 1969

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-20

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

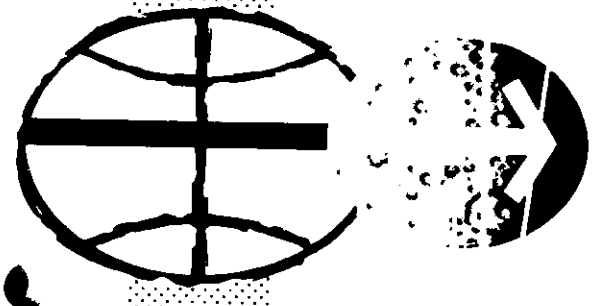
MSC INTERNAL NOTE NO. CF-R-69-12

LM RENDEZVOUS PROCEDURES

F MISSION

FINAL

REVISION A



Flight Procedures Branch

FLIGHT CREW SUPPORT DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

APRIL 28, 1969

NARA SW Box E209B-20

Low

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

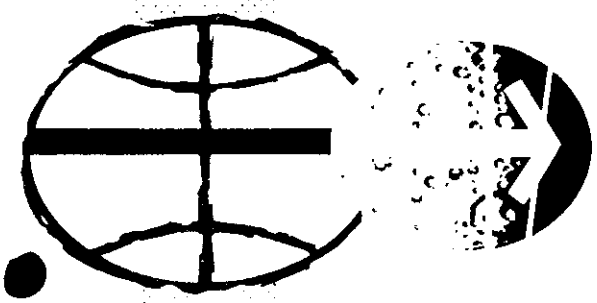
MSC INTERNAL NOTE NO. CF-R-69-23

LM RENDEZVOUS PROCEDURES

G MISSION

FINAL
REVISION A

JUNE 20,1969



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE MSC-CF-D-69-17

MISSION TRAINING PROGRAM FOR THE FOURTH MANNED APOLLO MISSION

PREPARED BY

MISSION TRAINING SECTION
MISSION OPERATIONS BRANCH
FLIGHT CREW SUPPORT DIVISION

FEBRUARY 15, 1969

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HOUSTON, TEXAS

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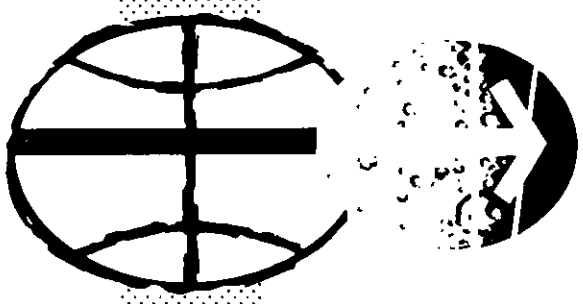
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC EG - 69 - 5

PROJECT APOLLO

CSM STEERING OF SATURN SIVB DURING TRANSLUNAR INJECTION



MANNED SPACECRAFT CENTER
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February 18, 1969

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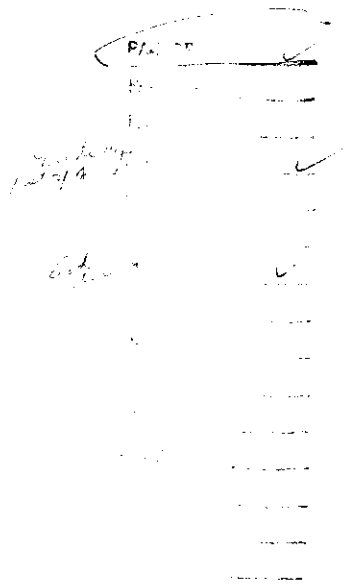
PA

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC EG - 69 - 7

PROJECT APOLLO

RANGEFINDER TESTS FOR THE D MISSION RENDEZVOUS



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February 26, 1969

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 9

PROJECT APOLLO

GUIDANCE LAWS FOR CONTROLLING OFF - NOMINAL LM POWERED DESCENT TRAJECTORIES BACK TO THE NOMINAL

CONTROL REQUIREMENTS BRANCH
GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

February 28, 1969

NARA SW Box E209B-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 12

PROJECT APOLLO

DISPERSION ANALYSIS OF MISSION D RENDEZVOUS USING DEGRADED RENDEZVOUS RADAR

SYSTEMS ANALYSIS BRANCH
GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

March 6, 1969

NARA SW Box E209B-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 14

PROJECT APOLLO

LM LANDING RADAR TEST FOR THE F MISSION

SYSTEMS ANALYSIS BRANCH

GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

March 11, 1969

NARA SW Box E209B-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 16

PROJECT APOLLO

STABILITY ANALYSIS OF APOLLO BLOCK II CSM / LM THRUST VECTOR CONTROL SYSTEMS

SYSTEMS ANALYSIS BRANCH
GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

March 20, 1969

NARA SW Box E209B-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 18

PROJECT APOLLO

PERFORMANCE OF APOLLO BLOCK II THRUST VECTOR CONTROL USING THE PGNCS (PRIMARY GUIDANCE NAVIGATION AND CONTROL SYSTEM)

SYSTEMS ANALYSIS BRANCH
GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

April 8, 1969

NARA SW Box E209B-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 21

PROJECT APOLLO

STABILITY ANALYSIS OF APOLLO ATTITUDE CONTROL DURING SERVICE PROPULSION THRUSTING

SYSTEMS ANALYSIS BRANCH
GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

March 5, 1969

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 22

PROJECT APOLLO

SOME REDESIGNATION CHARACTERISTICS ATTRIBUTED TO SLOWING THE LM LANDING APPROACH TRAJECTORY

CONTROL REQUIREMENTS BRANCH
GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

May 30, 1969

NARA SW Box E209B-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 34

PROJECT APOLLO

DETAILED POST FLIGHT ANALYSIS OF DATA FROM APOLLO 9 INFLIGHT DYNAMICS TEST (STROKING TEST)

SYSTEMS ANALYSIS BRANCH
GUIDANCE AND CONTROL DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

September 4, 1969

NARA SW Box E209B-21

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 39

PROJECT APOLLO

TARGETING CONSIDERATIONS RELATIVE TO LANDING POINT REDESIGNATION USE TO MAXIMIZING THE CAPABILITY OF THE LUNAR MODULE TO LAND AT A SPECIFIED LOCATION

GUIDANCE AND CONTROL DIVISION

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HOUSTON, TEXAS

September 26, 1969

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-EX-001

A METHOD OF PREDICTING APOLLO DROGUE CHUTE RISER LOADS DURING THE INFLATION PROCESS

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MANNED SPACECRAFT CENTER

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January 29, 1969

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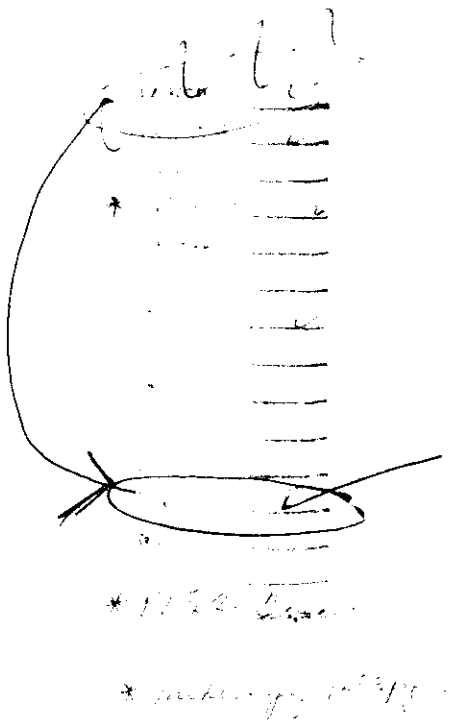
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

INTERNAL NOTE MSC - EG - 69 - 2

PROJECT APOLLO

CONSIDERATIONS IN LUNAR LANDMARK SIGHTING AND RECOMMENDED TECHNIQUES



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February 2, 1969

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CHANGE SHEET

FOR

MSC INTERNAL NOTE 69-FM-16 DATED JANUARY 29, 1969

MISSION G REQUIREMENTS FOR THE RTCC:

NOMINAL ASCENT AND ABORT FROM DESCENT

By Veit Hanssen

Change 1 by Charles Halliman

April 30, 1969

Floyd V. Bennett, Chief
Landing Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

After the attached replacement pages have been inserted, place this CHANGE SHEET between the cover and the title page and write on the cover, "CHANGE 1 inserted".

NOTE: A black bar in the margin indicates the area of change.

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-23

January 31, 1969

PRELIMINARY LM ABORT AND CSM RESCUE PLAN FOR APOLLO MISSION G

VOLUME IV

ABORTS FROM POWERED DESCENT

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-61

March 10, 1969

PRELIMINARY ABORT AND RESCUE PROCEDURES FOR APOLLO MISSION F

VOLUME III

TIME-CRITICAL PROCEDURES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM- 62

March 11, 1969

LINEARIZED IMPULSIVE EARTH APPROACH GUIDANCE ANALYSIS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-67

March 26, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO MISSION F VOLUME III - MISSION SUMMARIES: MAY 1969 LAUNCH WINDOW

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-72

March 26, 1969

PRELAUNCH GO/NO-GO COMPUTATIONS FOR THE APOLLO 9 MISSION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-73

May 9, 1969

GUIDANCE ANALYSIS OF AERODYNAMIC PHASE OF DESCENT TO THE SURFACE OF MARS

Advanced Mission Design Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-78

APRIL 9, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 10 (MISSION F)

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MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-81

April 11, 1969

LUNAR LANDMARK TRACKING ATTITUDE STUDIES

LUNAR MISSION ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-82

April 10, 1969

APOLLO 10 (MISSION F) SPACECRAFT OPERATIONAL ALTERNATE MISSION PLANS

VOLUME I

EARTH ORBITAL ALTERNATES

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-84

April 10, 1969

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 10 (MISSION F)

VOLUME I
NONTIME-CRITICAL PROCEDURES

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-85

April 9, 1969

APOLLO 10 (MISSION F) SPACECRAFT OPERATIONAL ALTERNATE MISSION PLANS

VOLUME III

LUNAR ALTERNATE RENDEZVOUS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-14

January 23, 1969

EFFECT OF VARIOUS PARAMETERS ON A MANUAL, CONSTANT g REENTRY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-89

May 26, 1969

APOLLO 7 ENTRY POSTFLIGHT ANALYSIS

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MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-90

May 14, 1969

LAUNCH WINDOW EFFECTS ON THE APOLLO 10 (MISSION F) OPERATIONAL ABORT PLANS

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MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-91

April 18, 1969

A DESCRIPTION OF THE INPUT TO THE APOLLO MISSION PLANNING AND REAL-TIME RENDEZVOUS SUPPORT PROGRAM

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-92

May 29, 1969

RTCC REQUIREMENTS FOR MISSION G: LANDING SITE DETERMINATION USING RENDEZVOUS RADAR AND OPTICAL OBSERVATIONS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-94

June 6, 1969

A MINIMUM ΔV, ONE-IMPULSE ORBIT TRANSFER PROBLEM SOLVED BY THE METHOD OF LAGRANGE MULTIPLIERS

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

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HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-95

April 25, 1969

REVISION 1
TO THE USERS' MANUAL FOR THE APOLLO GUIDANCE ANALYSIS STATISTICAL TRIALS PROGRAM

(This document supersedes MSC Internal Note No. 69-FM-53 dated March 3, 1969)

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-23

CHANGE SHEET

FOR

MSC INTERNAL NOTE 69-FM-95 DATED APRIL 25, 1969

REVISION 1

TO THE USERS' MANUAL FOR THE

APOLLO GUIDANCE ANALYSIS

STATISTICAL TRIALS PROGRAM

By Dennis M. Braley

Change 3

November 10, 1969

Edgar C. Lineberry, Chief
Orbital Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis
Division

NOTE: A black bar in the margin indicates the areas of change.

After the attached enclosures, which are replacements, have been inserted and the pen and ink changes listed below have been made, place this CHANGE SHEET between the cover and title page and write on the cover "CHANGE 3 inserted".

1. Prior to section 3 on page 15, insert "sections 3 through 5 are included only if IORB ≠ 2".

2. The last sentence in the definition of the vector on page 16a should start "if ISET ≠ 2, the vector is on one card".

3. The insertion prior to section 6 on page 16a should be changed to read "Sections 6 through 8 are included only if IORB ≠ 1".

4. The variable in section 7 (page 18) should read "DXA(LM)" instead of "CSA(LM)".

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-100

May 15, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR MISSION G VOLUME III MISSION SUMMARIES: JULY 1969 LAUNCH WINDOW

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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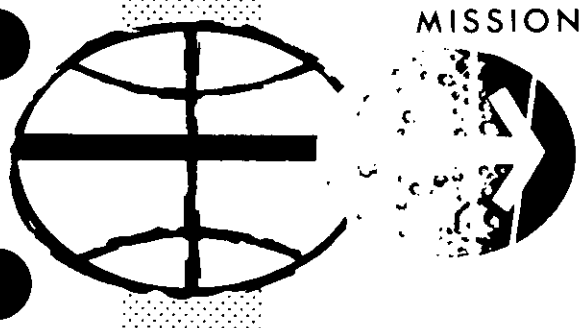

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-103

June 13, 1969

PRELIMINARY LUNAR ORBIT ATTITUDE

SEQUENCE FOR MISSION G

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-104

May 23, 1969

TLI SHIP POSITIONING AND COVERAGE DATA FOR MISSION G (APOLLO 11) LUNAR LAUNCH OPPORTUNITIES FOR JULY, AUGUST, AND SEPTEMBER 1969

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

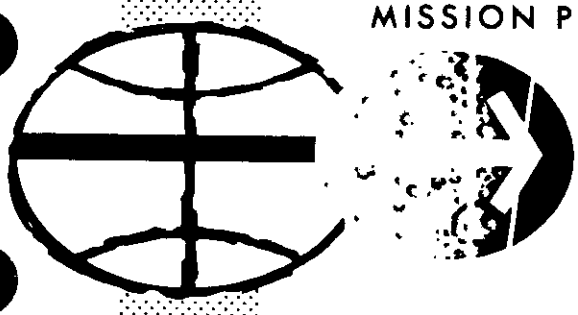
MSC INTERNAL NOTE NO. 69-FM-108

April 29, 1969

ENGINEERING NOMOGRAPH SHOWING CRATER VISIBILITY DURING LUNAR MODULE DESCENT

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NARA SW Box E209B-23

PA/G.M. Low

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-109

April 24, 1969

THE EFFECTS OF TLI MALFUNCTIONS ON MISSION F CREW MONITORING PROCEDURES

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

MSC FORM 2[illegible] (REV MAY 68)

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-110

April 24, 1969

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 10 (MISSION F)

SUPPLEMENT TO

VOLUME I

NON-TIME-CRITICAL PROCEDURES SPECIFIC CASE DATA

The attached document is a supplement to Volume I of the Apollo 10 LM Abort and Rescue Plan. This document presents specific data for nine abort and rescue cases and for the nominal case on which the abort and rescue plan is based.

The Operational LM Abort and Rescue Plans for the Apollo 10 mission are complete with the distribution of this document. No operational data will be published for the Time-Critical Procedures.

MANNED SPACECRAFT CENTER
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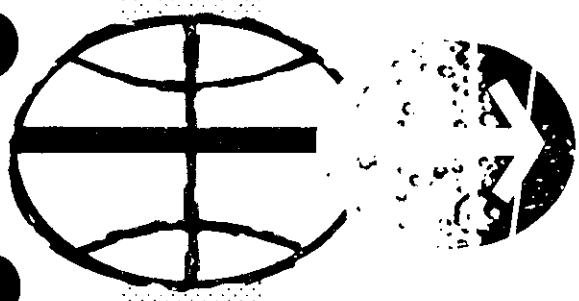
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-113

OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR MISSION F

April 23, 1969



LUNAR MISSION ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-114

May 1, 1969

LM DESCENT TRAJECTORY CONSTRAINTS IMPOSED BY CRATER VISIBILITY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISON

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-116

April 30, 1969

VISUAL REPRESENTATION OF THE ABORT RESET POINTS FOR APOLLO 10 (MISSION F)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-117

May 6, 1969

APOLLO 8
RTACF POSTMISSION REPORT

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-87

April 14, 1969

APOLLO 10 (MISSION F)

SPACECRAFT OPERATIONAL

ALTERNATE MISSION PLANS

VOLUME II

ALTERNATE LUNAR MISSIONS

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-119

May 12, 1969

RATIONALE FOR USING THE SATURN MONITOR AND ABORT CREW CHARTS FOR APOLLO 10 (MISSION F)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-121

May 2, 1969

APOLLO 10 (MISSION F) OPERATIONS REVIEW PRESENTED AT MSC ON APRIL 29, 1969

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-122

May 13, 1969

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 10 TRAJECTORY SUPPORT CHIEFS PROCEDURES HANDBOOK

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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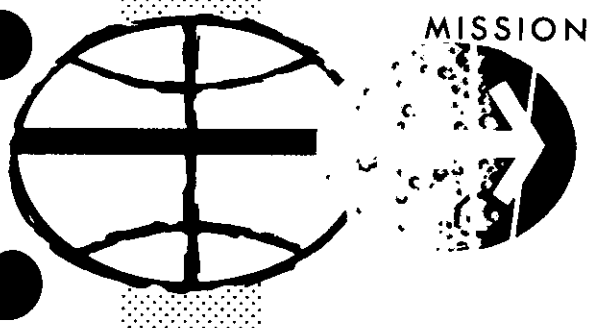

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-124

June 9, 1969

POSTFLIGHT EVALUATION OF THE APOLLO 8 EVASIVE MANEUVERS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-127

May 12, 1969

APOLLO 10 (MISSION F) VEHICLE AND TRAJECTORY RESPONSE TO THE CSM POWERED FLIGHT MANEUVERS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-129

May 12, 1969

VERIFICATION OF THE RTCC POWERED FLIGHT SIMULATION FOR APOLLO 10 (MISSION F)

Guidance and Performance Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

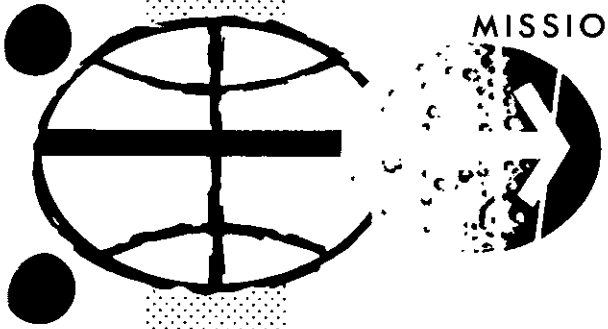
MSC INTERNAL NOTE NO. 69-FM-130

May 28, 1969

ENTRY MISSION PLAN
APOLLO 8 SUMMARY

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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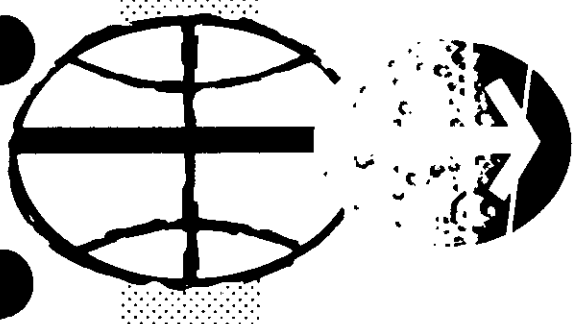
MSC INTERNAL NOTE NO. 69-FM-131

May 12, 1969

OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 10 FLIGHT ANNEX



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-132

May 9, 1969

REVISION 3
RTCC REQUIREMENTS FOR MISSIONS F AND G: EARTH ORBIT INSERTION PROCESSOR

(This revision supersedes MSC Internal Note No. 69-FM-58 dated March 7, 1969)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-133

May 16, 1969

CHANGES TO THE DKI LOGIC FOR APOLLO MISSION G AND SUBSEQUENT MISSIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-140

May 14, 1969

RTACF WORK SCHEDULE FOR APOLLO 10

FLIGHT ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-136

May 13, 1969

APOLLO 10 (MISSION F)
CREW CHARTS

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-141

May 14, 1969

SEPARATION PROCEDURES FOR APOLLO 10 NOMINAL, ALTERNATE, AND ABORT MISSIONS

FLIGHT ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION

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HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-118

May 9, 1969

COMPARISON OF THE CREW OPTICAL ALINEMENT SIGHT DEVICE AND THE SEXTANT DURING A TYPICAL RENDEZVOUS SEQUENCE

Mathematical Physics Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-144

May 15, 1969

APOLLO 10 SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO 69-FM-145

May 15, 1969

CISLUNAR NAVIGATION SIGHTING DATA FOR THE APOLLO 10 MISSION: MAY 1969 LAUNCH WINDOW

Mathmatical Physics Branch

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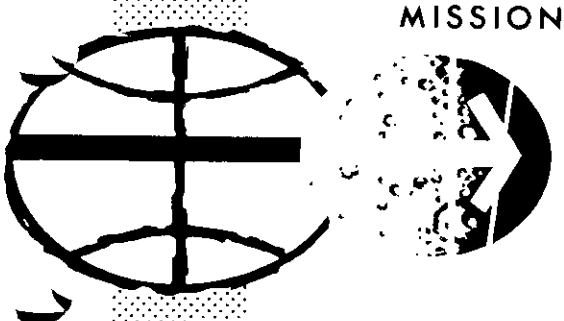
MSC INTERNAL NOTE NO. 69-FM-146

May 15, 1969

REENTRY TRAJECTORY CONTROL USING THE ENTRY MONITORING SYSTEM

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-149

June 2, 1969

AN EMPIRICAL TECHNIQUE FOR COMPUTING NAVIGATION COVARIANCE MATRICES AND THE APPLICATION OF THE TECHNIQUE TO POST APOLLO 8 LUNAR ORBIT MISSION PLANNING

Mathematical Physics Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-151

June 3, 1969

AN ANALYTIC METHOD FOR COMPUTING THE STATE TRANSITION MATRIX WHICH INCORPORATES THE SECULAR AND PERIODIC PERTURBATIONS OF THE SECOND HARMONIC (J_{20}) OF PLANET OBLATENESS

Advanced Mission Design Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-152

June 3, 1969

DEFINITION OF THE RTCC ASCENT PREDICTOR MONITORING LIMITS FOR PGNCS TO AGS SWITCHOVER DURING LM POWERED ASCENT

Guidance Performance Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-153

June 3, 1969

APOLLO 10 TRANSEARTH COMMUNICATION LOSS PROCEDURES

MATHEMATICAL PHYSICS BRANCH
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-154

JUNE 3, 1969

QUICKEST POSSIBLE RETURNS TO EARTH FOR APOLLO 11 (MISSION G) ABORTS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NO. 69-FM-155

June 9, 1969

HELIOCENTRIC ABORT ΔV REQUIREMENTS FOR 1977 THROUGH 1986 MARS CONJUNCTION-CLASS MISSIONS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-156

June 10, 1969

APOLLO 11 (MISSION G) SPACECRAFT DISPERSION ANALYSIS

VOLUME IV - DESCENT AND ASCENT DISPERSION ANALYSES

PART 1 - LUNAR DESCENT

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-158

June 9, 1969

PRELAUNCH GO/NO-GO COMPUTATIONS FOR THE APOLLO 10 MISSION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-143

May 13, 1969

APOLLO 10 SPACECRAFT DISPERSION ANALYSIS

VOLUME VI
DISPERSION SUMMARY

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-161

June 13, 1969

AN EFFICIENT METHOD FOR CARTESIAN TRANSFORMATIONS

Mathematical Physics Branch

Mission Planning and Analysis Division

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-162

June 13, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 11 (MISSION G)

Flight Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-163

June 16, 1969

AUTONOMOUS NAVIGATION IN LONG-DURATION HIGHLY ECCENTRIC ORBITS ABOUT MARS

Advanced Mission Design Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-165

June 16, 1969

AN ANALYSIS OF THE PERFORMANCE CAPABILITY AND VEHICLE DYNAMICS OF THE SATURN V LAUNCH VEHICLE FOR TWO-ENGINE-OUT MALFUNCTIONS

Flight Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-166

June 20, 1969

APOLLO 11 (MISSION G) DISPERSION ANALYSIS

VOLUME IV

DESCENT AND ASCENT DISPERSION ANALYSES

PART 2-LUNAR ASCENT

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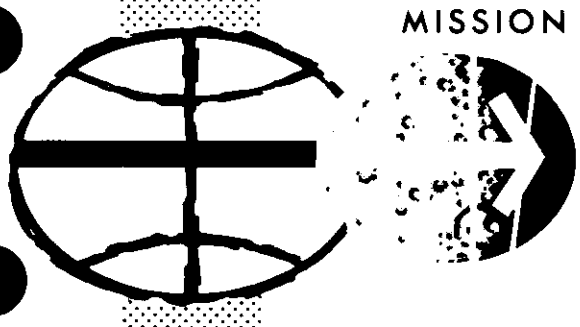
MSC INTERNAL NOTE NO. 69-FM-167

June 19, 1969

A CLOSED-FORM SOLUTION FOR MINIMUM-FUEL, CONSTANT-THRUST TRAJECTORIES

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-168

June 12, 1969

VIEWS FROM THE CM AND LM DURING THE FLIGHT OF APOLLO 11 (MISSION G)

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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MSC INTERNAL NOTE NO. 69-FM-169

August 25, 1969

PERFORMANCE CAPABILITIES FOR A LUNAR LANDING MISSION TO ARISTARCHUS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-174

June 24, 1969

APOLLO 11 (MISSION G)

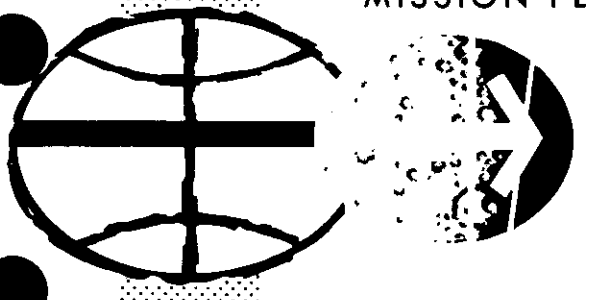
SPACECRAFT DISPERSION ANALYSIS

VOLUME III

LOI-1, LOI-2, PLANE CHANGE, AND TEI DISPERSIONS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-175

June 27, 1969

OPERATIONAL LM ABORT AND RESCUE PLAN FOR APOLLO 11 (MISSION G) VOLUME II RENDEZVOUS AND RESCUE

Orbital Mission Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-177

June 30, 1969

A PERFORMANCE STUDY OF THE ENTRY GUIDANCE LOGIC FOR ENTRY INTERFACE VELOCITIES OF 25 600 FPS, 25 800 FPS, AND 26 000 FPS AND FOR LIFT-TO-DRAG RATIO FROM 0.1000 TO 0.2000

Landing Analysis Branch

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-178

June 30, 1969

HYBRID MISSION EFFECTS ON THE LOI PHASE OF THE APOLLO 11 (MISSION G) ABORT PLAN

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MSC INTERNAL NOTE NO. 69-FM-179

July 3, 1969

RTCC REQUIREMENTS FOR MISSION H AND SUBSEQUENT MISSIONS: REENTRY PHASE

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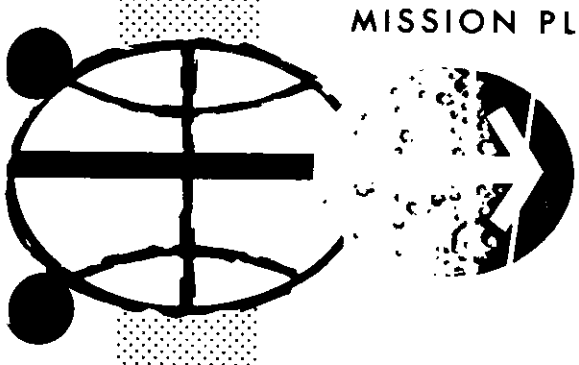
MSC INTERNAL NOTE NO. 69-FM-181

July 1, 1969

AN EVALUATION OF THE LOI ATTITUDE MONITORING PROCEDURE TECHNIQUE FOR DISPERSED TRANSLUNAR APPROACH HYPERBOLAS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-160

June 9, 1969

REVISION 1 TO THE ERROR SOURCE DATA FOR DISPERSION ANALYSES

(This revision supersedes MSC Internal Note No. 68-FM-297 dated December 13, 1968.)

Guidance and Performance Branch
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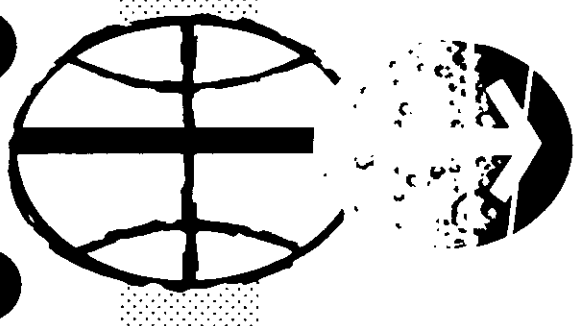
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-184

JUNE 30, 1969

APOLLO 11 (MISSION G)
SPACECRAFT DISPERSION ANALYSIS
VOLUME V
RENDEZVOUS DISPERSION ANALYSIS



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MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-187

July 3, 1969

ENTRY MISSION PLAN APOLLO 11

(MISSION G)

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-188

July 3, 1969

OPERATIONAL LM ABORT AND CSM RESCUE PLAN FOR APOLLO 11 (MISSION G) VOLUME I ABORTS FROM POWERED DESCENT AND ASCENT

Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-191

July 3, 1969

REVISION 1 TO THE CONSUMABLES ANALYSIS FOR THE APOLLO 11 (MISSION G) SPACECRAFT OPERATIONAL TRAJECTORY

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-192

July 2, 1969

REVISION 1 TO THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 11 (MISSION G) VOLUMNE II OPERATIONAL MISSION PROFILE TRAJECTORY PARAMETERS, LAUNCHED JULY 16, 1969

Lunar Mission Analysis Branch,
Orbital Mission Analysis Branch,
and
Landing Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-182

June 26, 1969

APOLLO 11 (MISSION G)

MISSION PLANNING BRIEFINGS

MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-201

July 8, 1969

APOLLO 11 (MISSION G) SPACECRAFT DISPERSION ANALYSIS VOLUME VII

DISPERSION SUMMARY

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

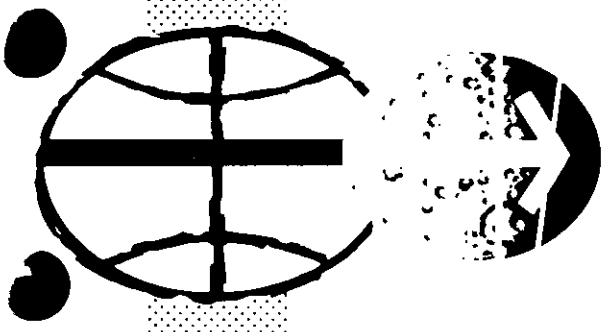
NARA SW Box E209B-28

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-202

July 8, 1969

OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR MISSION G



LUNAR MISSION ANALYSIS BRANCH
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-28

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE 69-FM-203

July 11, 1969

SEPARATION PROCEDURES FOR APOLLO 11 NOMINAL, ALTERNATE, AND ABORT MISSIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-204

July 14, 1969

APOLLO 10 RTACF POSTMISSION REPORT

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-28

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-205

July 14, 1969

VERIFICATION OF COMANCHE 55 ORBITAL NAVIGATION PROGRAM

Mathmatical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-28

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

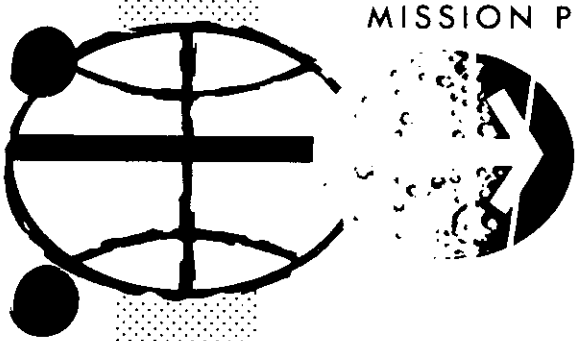
MSC INTERNAL NOTE NO. 69-FM-208

July 14, 1969

REVISION 1 TO THE APOLLO 11 (MISSION G) SPACECRAFT DISPERSION ANALYSIS VOLUME II TRANSLUNAR AND TRANSEARTH PHASES

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-215

July 23, 1969

A SURVEY OF 30-DAY STAYTIME ORBITAL MISSIONS TO VENUS (1972-2000)

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-28

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-216

July 24, 1969

A SOLUTION TO THE CONSTRAINED ALTITUDE PLANETARY FLYBY PROBLEM USING THE WEIGHTED LEAST SQUARES ITERATION TECHNIQUE

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-219

August 1, 1969

LANDING DISPERSION FOR A CONSTANT 4g REENTRY

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

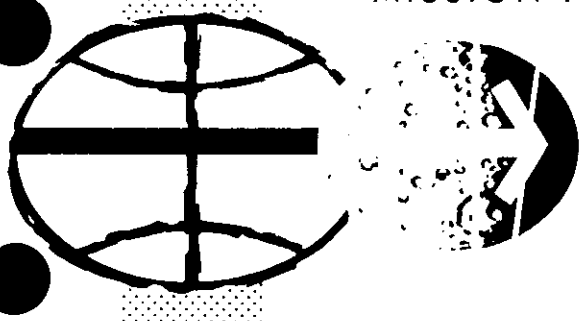
MSC INTERNAL NOTE NO. 69-FM-220

August 4, 1969

RECOMMENDED LOI PROCEDURES FOR HYBRID LUNAR MISSIONS

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION



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HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-224

August 12, 1969

SWITCHING LOGIC AND STEERING EQUATIONS FOR MULTIBURN EARTH ESCAPE MANEUVERS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-225

August 13, 1969

LOGIC AND EQUATIONS FOR THE REAL-TIME CALCULATIONS OF THE POWERED DESCENT ABORT CONSTANTS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-28

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

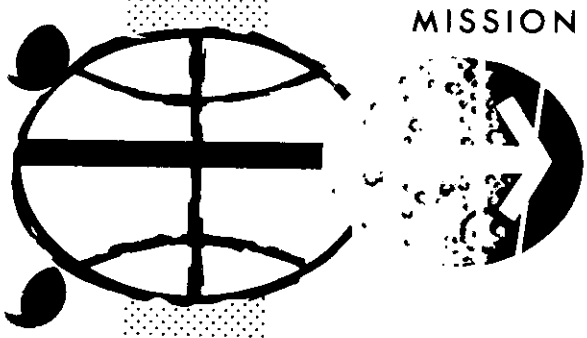
MSC INTERNAL NOTE NO. 69-FM-227

September 23, 1969

GUIDANCE ANALYSIS OF ENTRY CORRIDORS FOR AERODYNAMIC BRAKING INTO ORBIT AROUND MARS OR VENUS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-229

August 28, 1969

APOLLO APPLICATIONS PROGRAM TWO-AND-ONE-HALF-STAGES-TO-ORBIT TRACKING ANALYSIS

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-230

August 28, 1969

CSM BATTERY CHARGER MODEL

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-195

July 8,1969

APOLLO 11

(MISSION G)

ALTERNATE MISSION PLAN

Lunar Mission Analysis Branch

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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FILES

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-232

September 2, 1969

DESCRIPTION OF APOLLO GUIDANCE ANALYSIS STATISTICAL TRIALS PROGRAM

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-233

September 2, 1969

PRELIMINARY APOLLO 12 (MISSION H-1)

TRAJECTORY DATA

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-234

October 13, 1969

AN OPTIMAL, ANALYTIC SOLUTION TO THE LINEAR-GRAVITY, CONSTANT-THRUST TRAJECTORY PROBLEM

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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OCT 0 7 1969

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-236

September 10, 1969

APOLLO 9 ENTRY POSTFLIGHT ANALYSIS

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
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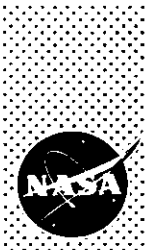

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-237

October 24, 1969

OPERATIONAL USE OF QUATERNIONS IN THE DESCRIPTION OF RIGID BODY MOTION

Mathematical Physics Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-238

September 10, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1970

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-241

September 18, 1969

AAP LM-ATM DECOUPLED MISSION STUDY

Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-243

October 21, 1969

APOLLO PORTABLE LIFE SUPPORT SYSTEM COMPUTER SIMULATION PROGRAM

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-244

September 19, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1971

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

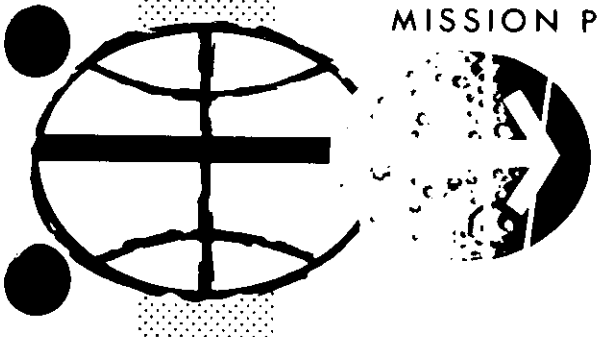
MSC INTERNAL NOTE NO. 69-FM-245

SEPTEMBER 22, 1969

TASK MONITOR'S HANDBOOK

Mission Planning Support Office

MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-246

September 22, 1969

PARAMETRIC ANALYSIS OF MSFN STATION COVERAGE FOR VARIOUS ORBITAL INCLINATIONS

Orbital Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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248 226

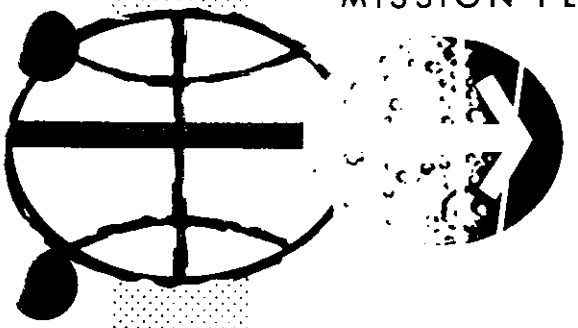
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-248

September 25, 1969

SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 12 (MISSION H-1) VOLUME I HYBRID MISSION PROFILE LAUNCHED NOVEMBER 14, 1969

Lunar Mission Analysis Branch,
Landing Analysis Branch,
and
Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS BRANCH



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-250

September 25, 1969

RTCC REQUIREMENTS FOR APOLLO 12 (MISSION H-1) TRANSLUNAR INJECTION PROCESSOR

(This revision supersedes MSC Internal Note No. 69-FM-132 dated June 5, 1969.)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-231

August 29, 1969

AAP INVERTER MODEL

Guidance and Performance Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-253

September 24, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1970

(This internal note supersedes MSC IN 69-FM-238 dated September 10, 1969)

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-30

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-254

September 30, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1972

Lunar Mission Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-30

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-256

OCTOBER 7, 1969

MINIMUM FLIGHT TIME AND FEASIBILITY OF MULTIPLE ORBIT TRANSFERS BETWEEN EARTH AND MARS AND BETWEEN EARTH AND VENUS

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-257

October 14, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 12 (MISSION H-1)

VOLUME II

EARTH PHASE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-30

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-258

October 14, 1969

COMPARISON OF PARALLEL AND TANDEM STAGING OF NUCLEAR ORBITAL LAUNCH STAGES FOR INTERPLANETARY DEPARTURE

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-259

October 14, 1969

OPERATIONAL ABORT PLAN

VOLUME IV

RETURN TO EARTH SUMMARY

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-260

October 14, 1969

APOLLO 12 (MISSION H-1) SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-261

October 13, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 12 (MISSION H-1)

VOLUME I

LAUNCH PHASE

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-263

OCTOBER 17, 1969

OPERATIONAL ABORT PLAN FOR APOLLO 12 (MISSION H-1) VOLUME III LUNAR PHASE

Flight Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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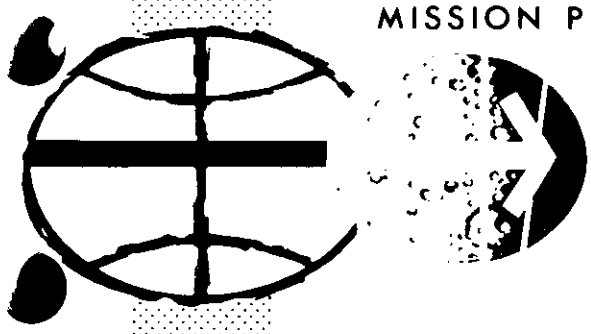
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-266

October 28, 1969

REVISION 1 TO THE SPACECRAFT OPERATIONAL TRAJECTORY FOR APOLLO 12 (MISSION H-1) VOLUME I HYBRID MISSION PROFILE LAUNCHED NOVEMBER 14, 1969

Lunar Mission Analysis Branch,
Landing Analysis Branch,
and Orbital Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-276

October 31, 1969

ADVANCED LUNAR EXPLORATION MISSION PLAN UTILIZING A POLAR ORBITING LUNAR SPACE STATION

Advanced Mission Design Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-282

November 4, 1969

APOLLO LUNAR TRACKING COVERAGE FOR 1973

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-252

APOLLO 8 ENTRY
POSTFLIGHT ANALYSIS

Landing Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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PA/ G.M. Low

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-305

November 12, 1969

APOLLO 12
LUNAR TRAJECTORY NOTES

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-31

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-313

December 2, 1969

PRELAUNCH GO/NO-GO COMPUTATIONS FOR THE APOLLO 12 MISSION

Flight Analysis Branch

MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NARA SW Box E209B-31

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 69-FM-304

November 10, 1969

FINAL OPERATIONAL SPACECRAFT ATTITUDE SEQUENCE FOR APOLLO 12 (MISSION H-1)

Lunar Mission Analysis Branch
MISSION PLANNING AND ANALYSIS DIVISION

MANNED SPACECRAFT CENTER
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MSC-00174

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

OCTOBER 31, 1969

APOLLO MISSION TECHNIQUES
MISSION H-1
CONTINGENCY PROCEDURES

TECHNIQUES DESCRIPTION

APOLLO SPACECRAFT PROGRAM OFFICE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-32

MSC-000175

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

OCTOBER 31, 1969

APOLLO MISSION TECHNIQUES
MISSION H-1
TRANSEARTH INJECTION, MIDCOURSE CORRECTIONS AND ENTRY

TECHNIQUES DESCRIPTION

APOLLO SPACECRAFT PROGRAM OFFICE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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MSC-00176

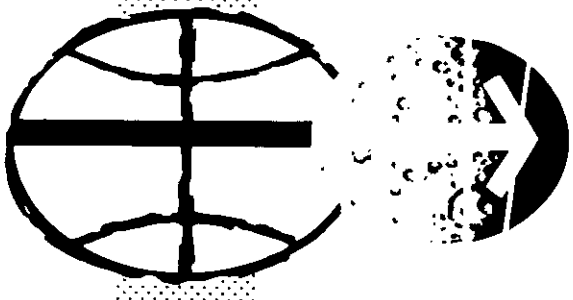
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

OCTOBER 17, 1969

APOLLO MISSION TECHNIQUES
MISSION H-1 LUNAR DESCENT

TECHNIQUES DESCRIPTION



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MSC-00178

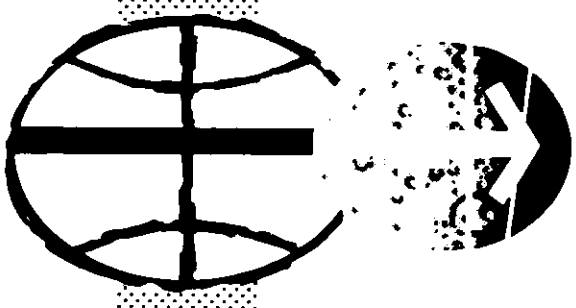
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

APOLLO MISSION TECHNIQUES
MISSION H-1
LUNAR SURFACE PHASE

TECHNIQUES DESCRIPTION

OCTOBER 15, 1969



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NARA SW Box E209B-32

11176-H349-R0-00

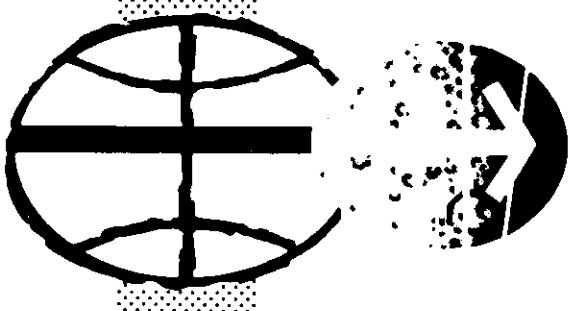
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. MSC-00-173

OCTOBER 31, 1969

COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR APOLLO 12 (H-1 MISSION)

VOLUME II
MISSION SUMMARY



TELE/COMMUNICATIONS SYSTEMS DIVISION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-32

MSC-01219

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

NOVEMBER 7, 1969

APOLLO MISSION TECHNIQUES
MISSION H-1
TRACKING DATA
SELECTION CONTROLLERS PROCEDURES

TECHNIQUES DESCRIPTION

APOLLO SPACECRAFT PROGRAM OFFICE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-33

MSC-01220

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

NOVEMBER 7, 1969

MISSION H-1
ABORT FROM LUNAR POWERED DESCENT AND SUBSEQUENT RENDEZVOUS

TECHNIQUES DESCRIPTION

APOLLO SPACECRAFT PROGRAM OFFICE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-33

MSC-01296

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

JANUARY 7, 1970

APOLLO MISSION TECHNIQUES
MISSION H-2 AND SUBSEQUENT

ABORT FROM LUNAR POWERED DESCENT AND SUBSEQUENT RENDEZVOUS

TECHNIQUES DESCRIPTION
FINAL ISSUE

APOLLO SPACECRAFT PROGRAM OFFICE
MANNED SPACECRAFT CENTER
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MSC-01297

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

JANUARY 30, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT LUNAR ORBIT ACTIVITIES

TECHNIQUES DESCRIPTION

FINAL ISSUE

APOLLO SPACECRAFT PROGRAM OFFICE
MANNED SPACECRAFT CENTER
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MSC-01517

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

MARCH 5, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT LAUNCH PHASE ABORTS

TECHNIQUES DESCRIPTION

FINAL ISSUE

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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MSC-01518

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

FEBRUARY 27, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT EARTH PARKING ORBIT AND TRANSLUNAR INJECTION

TECHNIQUES DESCRIPTION

FINAL ISSUE

APOLLO SPACECRAFT PROGRAM OFFICE
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-33

MSC-01519

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

APRIL 6, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT TRANSLUNAR MIDCOURSE CORRECTIONS AND LUNAR ORBIT INSERTION

TECHNIQUES DESCRIPTION FINAL ISSUE

APOLLO SPACECRAFT PROGRAM OFFICE
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MSC-01[illegible]

MSC INTERNAL NOTE

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT LUNAR DESCENT TECHNIQUES DESCRIPTION

February 15, 1970

APOLLO SPACECRAFT PROGRAM OFFICE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Approved by Howard W. Tindall, Jr.
Howard W. Tindall, Jr., Chief
Apollo Data Priority
Coordination

NARA SW Box E209B-33

MSC-01521

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

JANUARY 30, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT LUNAR SURFACE PHASE

TECHNIQUES DESCRIPTION

FINAL ISSUE

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MSC-01522

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

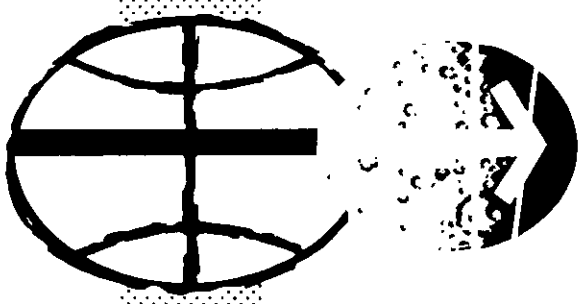
MSC INTERNAL NOTE

FEBRUARY 9, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT LUNAR POWERED ASCENT

TECHNIQUES DESCRIPTION

FINAL ISSUE



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MSC-01523

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

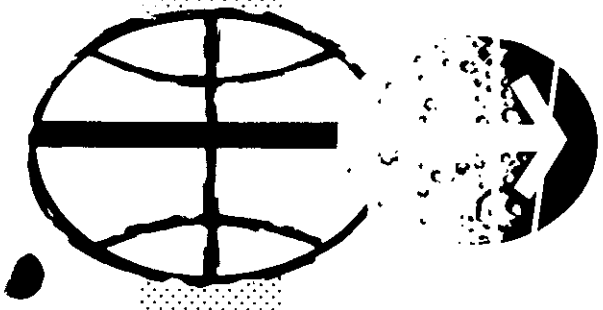
MSC INTERNAL NOTE

FEBRUARY 27, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT TRANSEARTH INJECTION, MIDCOURSE CORRECTIONS AND ENTRY

TECHNIQUES DESCRIPTION

FINAL ISSUE



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MSC-01524

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

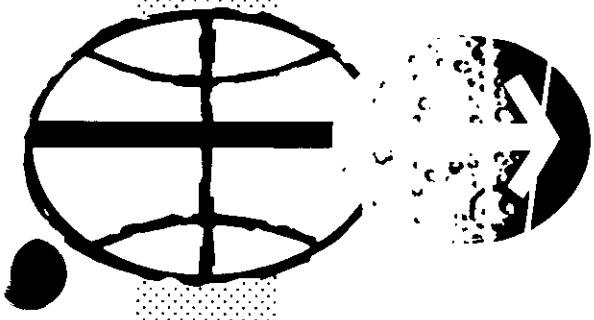
MSC INTERNAL NOTE

FEBRUARY 27, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT CONTINGENCY PROCEDURES

TECHNIQUES DESCRIPTION

FINAL ISSUE



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MSC-01525

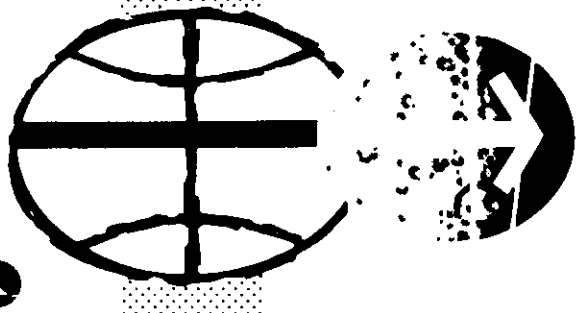
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

FEBRUARY 23, 1970

APOLLO MISSION TECHNIQUES MISSION H-2 AND SUBSEQUENT MANUAL ASCENT

TECHNIQUES DESCRIPTION FINAL ISSUE



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MSC-01526

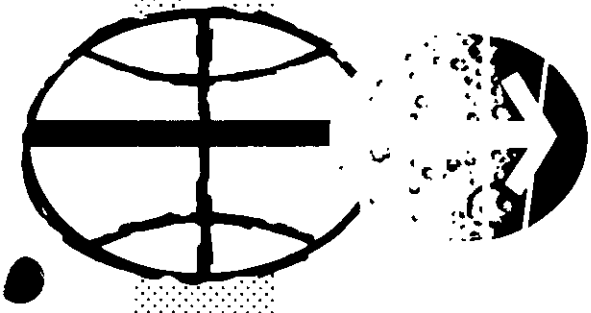
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

FEBRUARY 20, 1970

APOLLO MISSION TECHNIQUES
MISSION H-2 AND SUBSEQUENT
TRACKING DATA
SELECTION CONTROLLERS PROCEDURES

TECHNIQUES DESCRIPTION
FINAL ISSUE



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MSC 01212

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE

OCTOBER 30, 1969

APOLLO MISSION TECHNIQUES
MISSION H-1
LUNAR ORBIT ACTIVITIES

TECHNIQUES DESCRIPTION

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MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209B-33

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8M-036

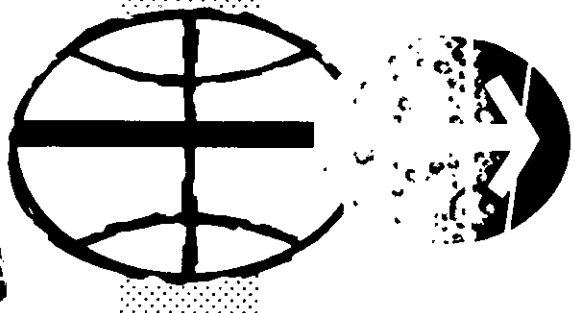
February 14, 1969

APOLLO MISSION TECHNIQUES
MISSION D RENDEZVOUS

VOLUME I

TECHNIQUES DESCRIPTION

(REVISION A)



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MSC INTERNAL NOTE NO. S-PA-9T-039

FEBRUARY 10, 1969

APOLLO MISSION TECHNIQUES
MISSION F AND G
EARTH PARKING ORBIT
AND
TRANSLUNAR INJECTION

VOLUME I
TECHNIQUES DESCRIPTION

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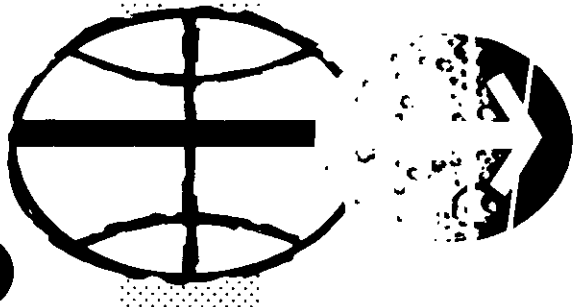
MSC INTERNAL NOTE NO. S-PA-9T-040

FEBRUARY 24, 1969

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
TRANSEARTH INJECTION, MIDCOURSE CORRECTIONS AND ENTRY

VOLUME 1
TECHNIQUES DESCRIPTION



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MSC INTERNAL NOTE NO. S-PA-9T-41

FEBRUARY 17, 1969

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
TRANSLUNAR MIDCOURSE CORRECTIONS AND LUNAR ORBIT INSERTION

VOLUME 1
TECHNIQUES DESCRIPTION

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MSC FORM 2026A (REV MAY 68)

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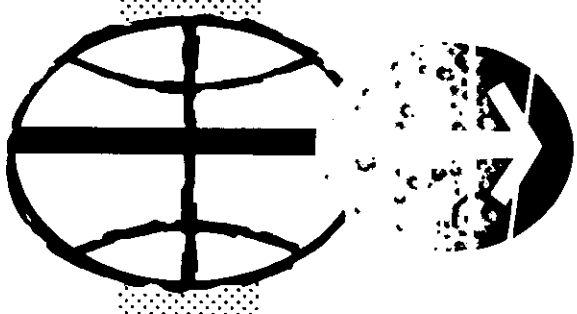
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-043

MARCH 24, 1969

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
CONTINGENCY PROCEDURES

TECHNIQUES DESCRIPTION



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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-044A

MAY 7, 1969

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
LUNAR ORBIT ACTIVITIES
REVISION A

VOLUME 1
TECHNIQUES DESCRIPTION

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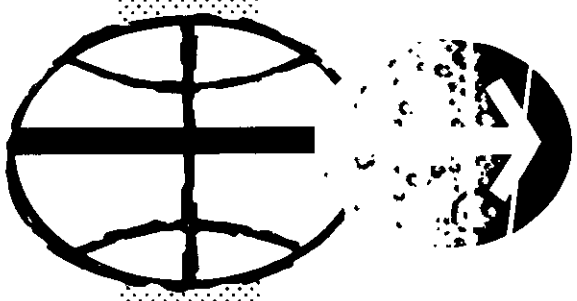
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-044

FEBRUARY 28, 1969

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
LUNAR ORBIT ACTIVITIES

VOLUME 1
TECHNIQUES DESCRIPTION



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MSC INTERNAL NOTE NO. S-PA-9T-045

FEBRUARY 25, 1969

APOLLO MISSION TECHNIQUES
MISSION D
MANEUVER MONITORING

VOLUME 1
TECHNIQUES DESCRIPTION

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MSC INTERNAL NOTE NO. S-PA-9T-046

MARCH 24, 1969

APOLLO MISSION TECHNIQUES
MISSION G
ABORT FROM LUNAR
POWERED DESCENT

TECHNIQUES DESCRIPTION

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MSC INTERNAL NOTE NO. S-PA-9T-048

MARCH 31, 1969

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
LAUNCH PHASE ABORTS

TECHNIQUES DESCRIPTION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-049

APRIL 9, 1969

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
TRACKING DATA
SELECTION CONTROLLERS PROCEDURES

TECHNIQUES DESCRIPTION

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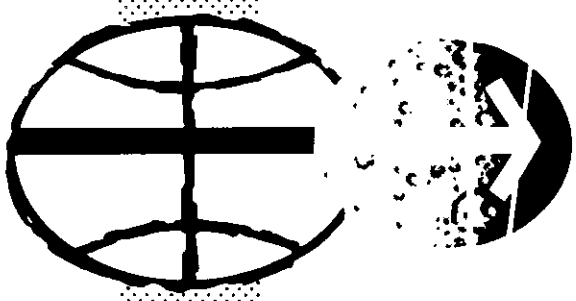
MSC INTERNAL NOTE NO. S-PA-9T-050

APOLLO MISSION TECHNIQUES
MISSION G
LUNAR SURFACE PHASE
REVISION A

TECHNIQUES DESCRIPTION

MAY 12, 1969



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MSC FORM 2026A (REV MAY 68)

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MSC INTERNAL NOTE NO. S-PA-9T-055

JULY 17, 1969

APOLLO MISSION TECHNIQUES
MISSION G
MANUAL ASCENT

TECHNIQUES DESCRIPTION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-128

JUNE 25, 1969

APOLLO MISSION TECHNIQUES
MISSION G
POWERED ASCENT

TECHNIQUES DESCRIPTION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-135

JUNE 30, 1969

APOLLO MISSION TECHNIQUES
MISSION G
LUNAR ORBIT ACTIVITIES

VOLUME 1
TECHNIQUES DESCRIPTION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-137

JUNE 30, 1969

MISSION G
ABORT FROM LUNAR POWERED DESCENT AND SUBSEQUENT RENDEZVOUS

TECHNIQUES DESCRIPTION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-9T-144

JULY 14, 1969

APOLLO MISSION TECHNIQUES
MISSION G
EARTH PARKING ORBIT
AND
TRANSLUNAR INJECTION

TECHNIQUES DESCRIPTION

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8N-021 A

JUNE 23, 1969

APOLLO MISSION TECHNIQUES
MISSION G LUNAR DESCENT
REVISION A

TECHNIQUES DESCRIPTION

APOLLO SPACECRAFT PROGRAM OFFICE
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HOUSTON, TEXAS

NARA SW Box E209B-34

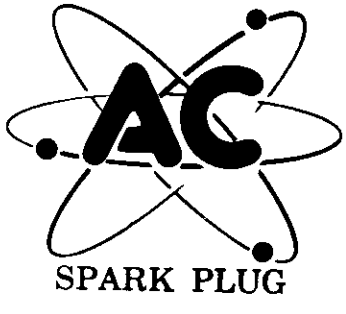
(168)

APOLLO

GUIDANCE AND NAVIGATION SYSTEM
INDUSTRIAL SUPPORT

ATTACHMENT NO. 1

ANALYSIS OF APOLLO COST PROPOSAL SUBMITTED BY AC SPARK PLUG DATED 12 JULY 1962



THE ELECTRONICS DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

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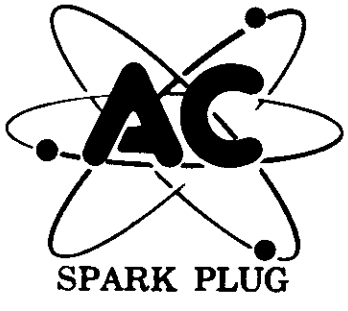
APOLLO

GUIDANCE AND NAVIGATION SYSTEM
INDUSTRIAL SUPPORT

RELIABILITY PROGRAM PLAN



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APOLLO
GUIDANCE AND NAVIGATION SYSTEM
for the

COMMAND MODULE
BLOCK I 100 SERIES

VOLUME I
BOOK 2

PRICE PROPOSAL

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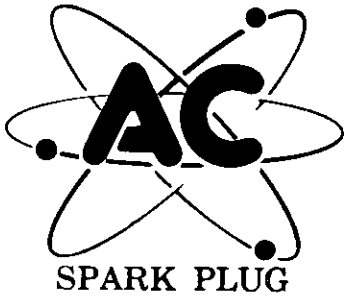
APOLLO

GUIDANCE AND NAVIGATION SYSTEM
INDUSTRIAL SUPPORT

VOLUME I
PRICE PROPOSAL



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for the

LUNAR EXCURSION MODULE

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BOOK 4

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for the

COMMAND MODULE
(BLOCK I, BLOCK I 100 SERIES, BLOCK II)
and the
LUNAR EXCURSION MODULE

VOLUME III
SUPPLEMENTAL DETAIL

BOOK 2

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GUIDANCE AND NAVIGATION SYSTEMS
for the

COMMAND MODULE
(BLOCK I, BLOCK I 100 SERIES, BLOCK II)
and the
LUNAR EXCURSION MODULE

VOLUME III
SUPPLEMENTAL DETAIL

BOOK 1

SPARK PLUG THE ELECTRONICS DIVISION OF GENERAL MOTORS CORPORATION

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[redacted]

APOLLO

COUPLING DISPLAY UNIT

VOLUME II
BUSINESS MANAGEMENT PROPOSAL

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MILWAUKEE 1, WISCONSIN

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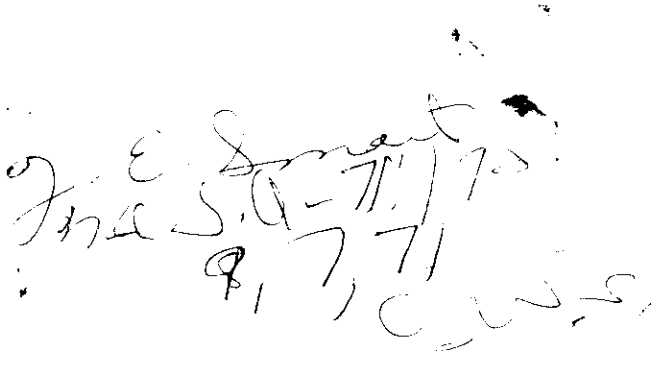
COUPLING DISPLAY UNIT

VOLUME III
PRICE PROPOSAL



AC
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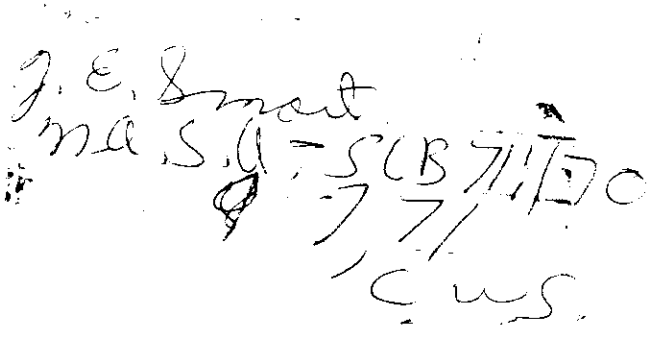
GROUND SUPPORT EQUIPMENT

VOLUME I
TECHNICAL PROPOSAL



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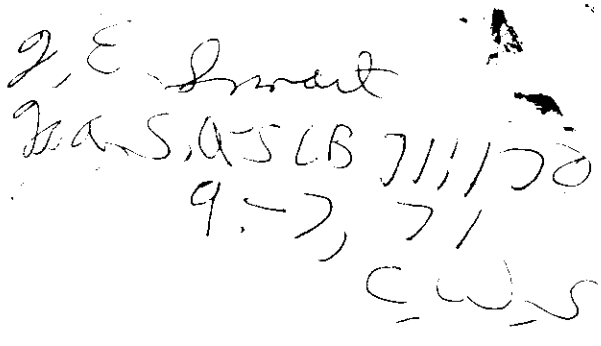
GROUND SUPPORT EQUIPMENT

VOLUME II
BUSINESS MANAGEMENT PROPOSAL



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GROUND SUPPORT EQUIPMENT

VOLUME III
PRICE PROPOSAL

J. E. Smart
71.A.S.A-5 CB 7/1/70
Q-7,74
C.W.S

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IMU POWER AND SERVO ASSEMBLIES

VOLUME I
TECHNICAL PROPOSAL

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8-7-71 E.W.S.

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VOLUME II
BUSINESS MANAGEMENT PROPOSAL

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INERTIAL MEASUREMENT UNIT

VOLUME I
TECHNICAL PROPOSAL

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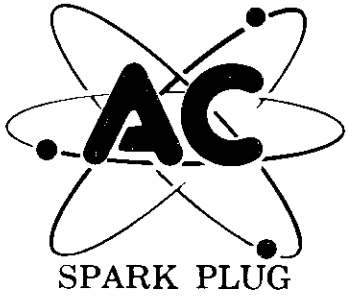
M.I.T. A-5 CB 7/1/70
9-7, 11 E.W.S.



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APOLLO

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VOLUME II
BUSINESS MANAGEMENT PROPOSAL

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VOLUME III
PRICE PROPOSAL

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SYSTEMS ASSEMBLY AND TEST

VOLUME I
TECHNICAL PROPOSAL

J. E. Smart
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9-3-71
CWS

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SYSTEMS ASSEMBLY AND TEST

VOLUME II

BUSINESS MANAGEMENT PROPOSAL

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9-7,71
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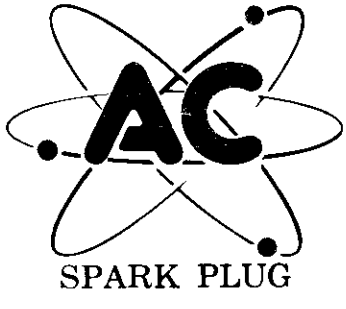

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VOLUME III
PRICE PROPOSAL

J. E. Smat
M.A.S.A.-SCB 11,170
8-7,71

SPARK PLUG

THE ELECTRONICS DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

[redacted]

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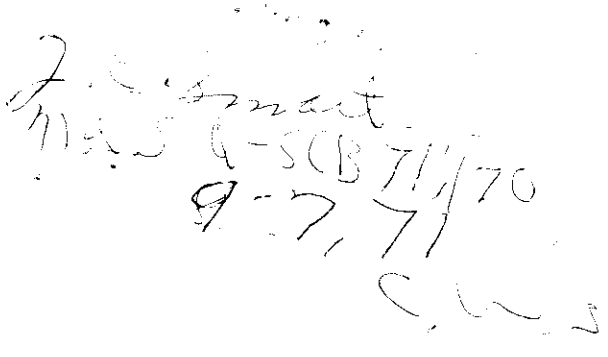
APOLLO

COUPLING DISPLAY UNIT

VOLUME I
TECHNICAL PROPOSAL



SPARK PLUG

THE ELECTRONICS DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

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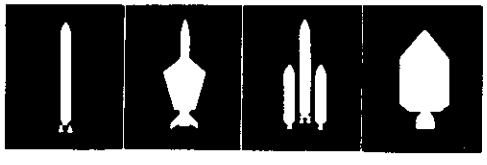
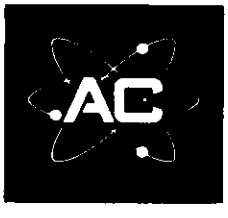
2-17-67

AC ELECTRONICS DIVISION GENERAL MOTORS CORPORATION MILWAUKEE, WISCONSIN

APOLLO OPTICAL SUBSYSTEMS

QUARTERLY PROGRAM REVIEW
4 OCTOBER 1966 THROUGH 17 FEBRUARY 1967





MASTER NAVIGATORS ... THROUGH TIME AND SPACE

NARA SW Box E209D-6

APOLLO
GUIDANCE COMPUTER

QUARTERLY PROGRAM REVIEW

2-17-67

NARA SW Box E209D-6

CONFIGURATION MANAGEMENT PROCEDURE

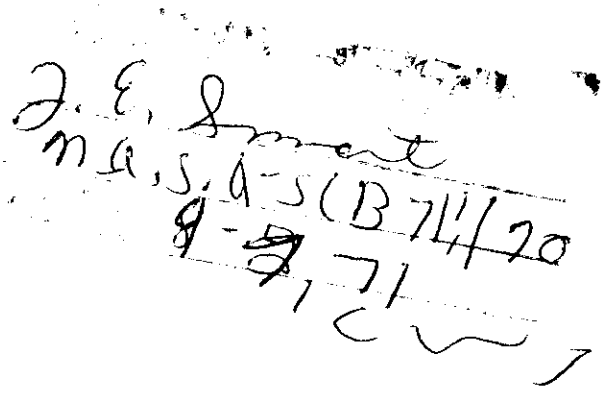
FOR 25 IRIG APOLLO II

AC SPARK PLUG
The Electronics Division
of
General Motors Corporation
Milwaukee, Wisconsin 53201

Issued: 1 September 1964

NARA SW Box E209D-6

~~CONFIDENTIAL~~



APOLLO

INERTIAL REFERENCE INTEGRATING GYRO (25 IRIG)

MODEL 2

PRICE PROPOSAL

AC Spark Plug Division, General Motors Corporation, Milwaukee 1, Wisconsin

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NARA SW Box E209D-7

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APOLLO

INERTIAL REFERENCE INTEGRATING GYRO (25 IRIG)

MODEL 2

TECHNICAL PROPOSAL

14

AC Spark Plug Division, General Motors Corporation, Milwaukee 1, Wisconsin

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NARA SW Box E209D-7

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J. E. Smart
NASA-SCB 7/1/70
$-771
1 C ~ S

APOLLO

INERTIAL REFERENCE INTEGRATING GYRO (25 IRIG)

MODEL 2

BUSINESS MANAGEMENT PROPOSAL

12

AC Spark Plug Division, General Motors Corporation, Milwaukee 1, Wisconsin

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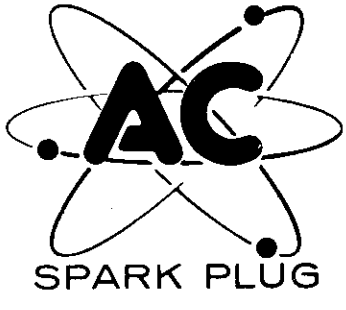
NARA SW Box E209D-7

APOLLO

25 IRIG
PROGRAM PLAN
REVISION A



THE ELECTRONICS DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

NARA SW Box E209D-7

APOLLO

GUIDANCE AND NAVIGATION SYSTEM
PARTICIPATING CONTRACTOR

MONTHLY TECHNICAL PROGRESS REPORT

NOVEMBER 1962

SPARK PLUG

THE ELECTRONICS DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

NARA SW Box E209D-7

62-250 Master 7.1

APOLLO

GUIDANCE AND NAVIGATION SYSTEM

PARTICIPATING CONTRACTOR

FAILURE REPORTING AND CORRECTIVE ACTION PLAN

AC Spark Plug

The Electronics Division

of

General Motors Corporation

Milwaukee 1, Wisconsin

62-250

15 November 1962

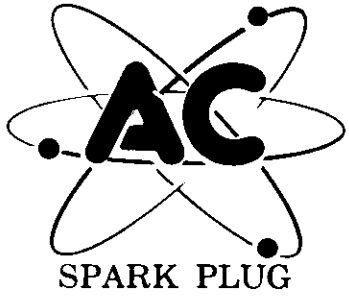
NARA SW Box E209D-7

APOLLO

GUIDANCE AND NAVIGATION SYSTEM
PARTICIPATING CONTRACTOR

MONTHLY RELIABILITY
PROGRESS REPORT

NOVEMBER 1962



THE ELECTRONICS DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

NARA SW Box E209D-7

APOLLO

GUIDANCE AND NAVIGATION SYSTEM
PARTICIPATING CONTRACTOR

QUARTERLY TECHNICAL PROGRESS REPORT

JANUARY 1963

SPARK PLUG

THE ELECTRONICS DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

NARA SW Box E209D-7

APOLLO

GUIDANCE AND NAVIGATION SYSTEM

MONTHLY TECHNICAL PROGRESS REPORT

31 January 1963

Prepared for

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge 39, Massachusetts

Prepared by

AC Spark Plug

The Electronics Division
of
General Motors Corporation

Milwaukee 1, Wisconsin

Participating Contractor with MIT/IL
for
NASA Contract NAS 9-497

63-2-A

15 February 1963

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APOLLO

GUIDANCE AND NAVIGATION SYSTEM

QUARTERLY TECHNICAL PROGRESS REPORT

1 January Through 31 March 1963

Prepared for

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge 39, Massachusetts

Prepared by

AC Spark Plug

The Electronics Division
of
General Motors Corporation

Milwaukee 1, Wisconsin

Participating Contractor with MIT/IL
for
NASA Contract NAS 9-497

63-2C

30 April 1963

NARA SW Box E209D-7

APOLLO

GUIDANCE AND NAVIGATION SYSTEM

MONTHLY TECHNICAL PROGRESS REPORT

April 1963

NASA Letter Contract NAS 9-497

Prepared for

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge 39, Massachusetts

Prepared by

AC Spark Plug

The Electronics Division
of
General Motors Corporation

Milwaukee 1, Wisconsin

Participating Contractor with MIT/IL
for
NASA Contract NAS 9-497

63-2D

15 May 1963

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GUIDANCE AND NAVIGATION SYSTEM

MONTHLY TECHNICAL PROGRESS REPORT

May 1963

NASA Letter Contract NAS 9-497

Prepared for

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge 39, Massachusetts

Prepared by

AC Spark Plug

The Electronics Division
of
General Motors Corporation

Milwaukee 1, Wisconsin

Participating Contractor with MIT/IL
for
NASA Contract NAS 9-497

63-2E

15 June 1963

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GUIDANCE AND NAVIGATION SYSTEM

QUARTERLY TECHNICAL PROGRESS REPORT

1 April 1963 — 30 June 1963

NASA Letter Contract NAS 9-497

Prepared for

Massachusetts Institute of Technology
Instrumentation Laboratory
Cambridge 39, Massachusetts

Prepared by

AC Spark Plug
The Electronics Division
of
General Motors Corporation
Milwaukee, Wisconsin 53201

Participating Contractor with MIT/IL
for
NASA Contract NAS 9-497

63-2F

31 July 1963

NARA SW Box E209D-7

SPARK PLUG
THE Electronics DIVISION OF GENERAL MOTORS
MILWAUKEE 1, WISCONSIN

3 September 1963
AP-M-1170

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston 1, Texas

Attention: Apollo Document Control Group

Subject: Transmittal of Monthly Technical Progress Report for Period Ending 31 July 1963

Reference: MIT/IL Technical Directive A-63

Gentlemen:

Transmitted herewith are sixty (60) copies of the subject report. AC Spark Plug Division is submitting this report in accordance with the requirements of paragraph 1B of the referenced Technical Directive.

Very truly yours,

AC SPARK PLUG DIVISION
General Motors Corporation

R. Hanson,
Contracts Administration

JFP:cb

Enclosures

CC: W. Rhine
M. Holzman

NARA SW Box E209D-7

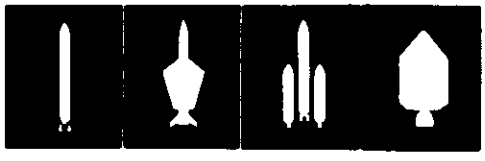
AC ELECTRONICS DIVISION GENERAL MOTORS CORPORATION MILWAUKEE WISCONSIN

APOLLO
PROGRAM REVIEW MEETING

SCHEDULE STATUS

CONTRACT NAS 9-497

16 FEBRUARY 1967



MASTER NAVIGATORS ... THROUGH TIME AND SPACE

NARA SW Box E209D-7

11176-H215-R0-00

PLAN FOR VERIFYING THE MSC/LMS SIMULATION OF AGS/FP6

April 1969

Prepared for:

National Aeronautics and Space Administration
Manned Spacecraft Center, Houston, Texas
Under Contract No. NAS 9-8166

Submitted by:

E. A. Mellon

NARA SW Box E209H-100

APOLLO COMMUNICATION SYSTEMS

TASK E-59B

TECHNICAL REPORT

CSM HIGH GAIN ANTENNA/LM

STEERABLE ANTENNA LOOK ANGLE CONVERSIONS

NAS 9-8166

7 May 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Communications and Sensor Systems Department
Electronic Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-100

11176-H220-R0-00

PROJECT TECHNICAL REPORT

TASK E-53C-2

CSM HGA TRACKING SYSTEM
NON-LINEAR INTERCHANGEABILITY STUDY
INTERIM TECHNICAL REPORT

NAS 9-8166

6 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Communication and Sensor Systems Department
Electronics Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-100

APOLLO COMMUNICATION SYSTEMS

TASK E-58B

TECHNICAL REPORT

APOLLO SPACECRAFT COMMUNICATION PARAMETER CORRELATION

NAS 9-8166

9 May 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Communication and Sensor Systems Department
Electronic Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-100

11176-H228-R0-00

PROJECT TECHNICAL REPORT
TASK E-45B

APOLLO HEAT SHIELD FLIGHT DATA
SUMMARY

NAS 9-8166

29 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
D. C. Gardner
R. E. Seward

Approved by R. G. Payne
R. G. Payne, Manager
Thermodynamics Department

Approved by Emily W. Stephens
E. W. Stephens
MSC Task Monitor
Thermal Technology Branch
Structures and Mechanics
Division

TRW
SYSTEMS GROUP

NARA SW Box E209H-100

11176-H230-R0-00

PROJECT TECHNICAL REPORT

TASK ASPO-32

MSC AGS FP5 TESTING FINAL ANALYSIS REPORT

NAS 9-8166

9 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
R. P. Kehl
J. E. Kastelein
L. P. Busick

NARA SW Box E209H-100

11176-H231-R0-00

PROJECT TECHNICAL REPORT
TASK E-72A

EVALUATION OF APOLLO 8 MISSION ONBOARD NAVIGATION DATA

NAS 9-8166

7 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

T. Phythian
D. Marx
W. Ferry
R. Kidd

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NARA SW Box E209H-100

11176-H214-R0-00

PROJECT TECHNICAL REPORT
TASK E-38B

APOLLO 10
GN&C PREFLIGHT PERFORMANCE REVIEW

NAS 9-8166

2 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Guidance and Control System Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-100

11176-H232-R0-00

PROJECT TECHNICAL REPORT

TASK E-38B

APOLLO IX GUIDANCE, NAVIGATION AND CONTROL SYSTEM PERFORMANCE ANALYSIS REPORT

NAS 9-8166

15 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Guidance and Controls Systems Department
Electronic Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-101

APOLLO COMMUNICATIONS SYSTEMS
TASK E-59B
TECHNICAL NOTE

TELEMETRY SYSTEM MEASUREMENT LOCATOR LIST LM-5

NAS 9-8166

29 MAY 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

Communications and Sensor Systems Department
Electronics Systems Laboratory

TRW SYSTEMS GROUP

NARA SW Box E209H-101

PROJECT TECHNICAL REPORT

TASK ASPO-59

MSFTP-2 BIT SYNCHRONIZER PERFORMANCE ANALYSIS

NAS 9-8166 27 May 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

Communication and Sensor Systems Department
Electronic Systems Laboratory

TRW SYSTEMS GROUP

NARA SW Box E209H-101

11176-H237-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION G/LM-5/APS PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

June, 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
P. F. Thompson
C. G. Johnston
Members of the Technical Staff
Propulsion Technology Section
Power Systems Department

Approved by: P. H. Janak
P. H. Janak, Head
Propulsion Technology Section

Approved by: D. W. Vernon
D. W. Vernon, Manager
Task E-19D
Power Systems Department

TRW SYSTEMS GROUP

NARA SW Box E209H-101

11176-H238-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-53C-2

NAS 9-8166

29 MAY 1969

AN INVESTIGATION OF THE LUNAR MULTIPATH PROBLEMS ASSOCIATED WITH THE APOLLO SPACECRAFT S-BAND TRACKING ANTENNAS

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-101

11176-H241-R0-00

PROJECT TECHNICAL REPORT

ASPO-62

OVERALL ACCURACY OF EMU BIOMEDICAL SUIT DATA

NAS 9-8166

2 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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SYSTEMS GROUP

NARA SW Box E209H-101

11176-H242-R0-00

PROJECT TECHNICAL REPORT

TASK KM-205

CSM/LMA G&C SYSTEMS REQUIREMENTS AND CAPABILITIES REPORT (SRCR) DEVELOPMENT PLAN

NAS 9-8166

2 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Guidance Analysis and Software Department
Guidance and Control Systems Department

TRW SYSTEMS GROUP

NARA SW Box E209H-101

11176-H243-R0-00

PROJECT TECHNICAL REPORT
TASK E&DD E-66A

BOUNDARY LAYER TRANSITION STUDY

NAS 9-8166

3 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS GROUP

NARA SW Box E209H-101

11176-H244-R0-00

PROJECT TECHNICAL REPORT

TASK E-45B

MULTI-COMPONENT, FOREIGN SPECIES INJECTION, HEAT TRANSFER, SKIN FRICTION, AND MASS TRANSFER CORRELATIONS FOR THE HYPERSONIC, LAMINAR BOUNDARY LAYER IN THE STAGNATION REGION INCLUDING CHEMICAL REACTIONS

NAS 9-8166

30 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-101

11176-H232-R0-00

PROJECT TECHNICAL REPORT

TASK E-38B

APOLLO IX GUIDANCE, NAVIGATION AND CONTROL SYSTEM PERFORMANCE ANALYSIS REPORT

NAS 9-8166 REVISION 1 15 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Approved by J E Alexander
J. E. Alexander, Manager
Guidance and Control
Systems Department

TRW SYSTEMS GROUP

NARA SW Box E209H-101

11176-H256-R0-00

PROJECT TECHNICAL REPORT

TASK E-45B

STANDARD ABLATION PROGRAM (STAB II)
USER'S MANUAL

NAS 9-8166

30 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-102

11176-H266-R0-00

PROJECT TECHNICAL REPORT

APOLLO 9
LM-3
DESCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166 16 June 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
R.K.M. Seto
Propulsion Technology Section
Power Systems Department

Approved by: _____
P. H. Janak, Head
Propulsion Technology Section

Approved by: _____
D. W. Vernon, Manager
Task E-19D

TRW SYSTEMS GROUP

NARA SW Box E209H-102

LM AND CSM S-BAND ANTENNA TRACKING STUDIES
TASK E-53C-2
TECHNICAL REPORT

LM AND CSM S-BAND ANTENNA TRACKING PROGRESS REPORT
(FOR FISCAL YEAR ENDING 30 JUNE 1969)

NAS 9-8166

27 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Communications and Sensor Systems Department
Electronics Systems Laboratory

TRW SYSTEMS GROUP

NARA SW Box E209H-102

11176-H272-R0-00

PROJECT TECHNICAL REPORT

TASK E-78B

APOLLO MISSION G
SPACECRAFT TO SPACECRAFT VHF COVERAGE

NAS 9-8166

26 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-102

11176-H273-R0-00

PROJECT TECHNICAL REPORT
TASK E-74

LM-5 FINAL DATA ANALYSIS

NAS 9-8166

27 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Guidance and Control Systems Department
Electronics Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-102

11176-H275-R0-01

PROJECT TECHNICAL REPORT
TASK E-74

LUMINARY - LM-5
SFRR DISCREPANCY REPORT
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166 REVISION I 9 JULY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-102

APOLLO COMMUNICATIONS SYSTEMS
TASK E-59B
TECHNICAL NOTE

APOLLO 12 TELEMETRY SYSTEM MEASUREMENT LOCATOR LIST CSM-108/LM-6

NAS 9-8166

3 July 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

Communications and Sensor Systems Department
Electronics Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-102

11176-H254-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 JUNE 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-102

11176-H289-R0-00

PROJECT TECHNICAL REPORT
TASK E-74

CSM - 107G MISSION FINAL DATA ANALYSIS
HYBRID SIMULATION DATA MANAGEMENT SUPPORT

NAS 9-8166

9 JULY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-103

11176-H297-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34E

LANDING RADAR ERROR MODEL BASED UPON REPROCESSED PEARL DATA

NAS 9-8166

21 JULY 1969

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared By

Communications and Sensor Systems Department
Electronics Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-103

11176-H298-R0-00

PROJECT TECHNICAL REPORT

APOLLO 9
LM-3
ASCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166

July 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
P. F. Thompson
W. G. Griffin
Members of the Technical Staff
Propulsion Technology Section
Power Systems Department

Approved by: _____
P. H. Janak, Head
Propulsion Technology Section

Approved by: _____
D. W. Vernon, Manager
Power Systems Department

Approved by: _____
R. J. Smith, Manager
Task E-19E

TRW SYSTEMS GROUP

NARA SW Box E209H-103

11176-H299-R0-00

PROJECT TECHNICAL REPORT

TASK E-78B

SUMMARY TECHNICAL REPORT
SPACECRAFT TO SPACECRAFT VHF COVERAGE

1 June 1968 - 1 June 1969

NAS 9-8166

23 July 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-103

11176-H301-R0-00

SPACECRAFT SYSTEMS ANALYSIS PROJECT

TECHNICAL REPORT

TASK E-34E

ERROR ANALYSIS OF THE RENDEZVOUS RADAR RANGE, RANGE RATE, SHAFT AND TRUNNION FUNCTIONS - FINAL REPORT

NAS 9-8166

24 July 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

Communications and Sensor Systems Department
Electronic Systems Laboratory

NARA SW Box E209H-103

11176-H306-R0-00

SPACECRAFT SYSTEMS ANALYSIS PROJECT

TECHNICAL REPORT

TASK E-34E

LM-4 LANDING RADAR PERFORMANCE ANALYSIS

NAS 9-8166

31 July 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

Communications and Sensor Systems Department
Electronic Systems Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-103

11176-H307-R0-00

PROJECT TECHNICAL REPORT

TASK ASPO-32

MSC/GCD TESTING OF AGS FP6

FINAL ANALYSIS REPORT

NAS 9-8166

July 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

J. E. Kastelein
L. P. Busick

NARA SW Box E209H-103

11176-H309-R0-00

ANTENNA AND PROPAGATION STUDIES FOR SPACECRAFT

TASK E-53D

TECHNICAL REPORT

ANALYSIS OF THE LM STEERABLE ANTENNA TRACKING ANOMALY ON THE APOLLO 11 MISSION

NAS 9-8166

8 AUGUST 1969

Prepared for

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11176-H287-R0-00

PROJECT TECHNICAL REPORT

TASK E-72A

DIGITAL AUPOPILOT SOFTWARE VERIFICATION TEST RESULTS FOR THE APOLLO 11 MISSION - LUMINARY IA

NAS 9-8166

14 JULY 1969

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SPACECRAFT SYSTEMS ANALYSIS PROJECT

TECHNICAL REPORT

TASK E-34E

FINAL LR REFLECTIVITY MODEL

NAS 9-8166

11 August 1969

Prepared for

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PROJECT ENGINEERING REPORT
TASK ASPO-83A

PRELIMINARY RESULTS OF LAUNCH MISSION RULES PRELAUNCH REDLINE DATA EVALUATION

NAS 9-8166

18 AUGUST 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H315-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 AUGUST 1969

Prepared for
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11176-H349-R0-00

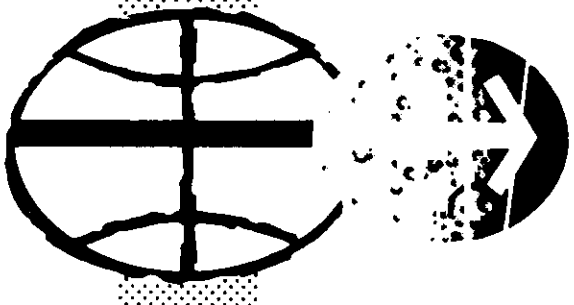
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. MSC-00-173

OCTOBER 31, 1969

COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR APOLLO 12 (H-1 MISSION)

VOLUME II
MISSION SUMMARY



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BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 OCTOBER 1969

Prepared for
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11176-H381-R0-00

PROJECT TECHNICAL REPORT
TASK E-38C

APOLLO GUIDANCE NAVIGATION AND CONTROL SYSTEM DATA PROCESSING PLAN

NAS 9-8166

2 MARCH 1970

REVISION 1

Prepared for
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11176-H396-RO-00

LM AGS FLIGHT PROGRAM 7 SIM FLIGHT OPERATING PROCEDURES

27 January 1970

Prepared For:
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11176-H311-R0-00

PROJECT TECHNICAL REPORT

APOLLO 9
CSM 104
SERVICE PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166

4 August 1969

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11176-H422-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION H2/LM-7/APS PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

January 1970

Prepared for
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PROJECT TECHNICAL REPORT

APOLLO 11
LM-5
ASCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166

November 1969

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11176-H433-R0-00

PROJECT TECHNICAL REPORT
TASK E-38C

APOLLO XI GUIDANCE, NAVIGATION AND CONTROL SYSTEMS PERFORMANCE ANALYSIS REPORT

NAS 9-8166

31 DECEMBER 1969

Prepared for
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11176-H450-R0-00

B.M 86

PROJECT TECHNICAL REPORT
TASK E-59C

ESTL VOICE INTELLIGIBILITY
PHASE III TEST ACCURACY ANALYSIS

NAS 9-8166

30 January 1970

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H454-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34E

LANDING RADAR DATA ANALYSIS FINAL REPORT

H-1 MISSION

NAS 9-8166

30 January 1970

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H454-R0-01

SPACECRAFT SYSTEMS ANALYSIS PROJECT

TECHNICAL REPORT

TASK E-34F

LANDING RADAR DATA ANALYSIS FINAL REPORT, H-1 MISSION (REVISION 1)

NAS 9-8166 1 April 1970

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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J.R.W. Letter 70.7251.1-631
4-1-70 Task 34E

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11176-H456-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

REVIEW OF GAEC FMES/FCI HYBRID SIMULATOR MATH MODELS AND CONTROL DATA FOR H MISSIONS

NAS 9-8166

30 JANUARY 1970

Prepared for
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11176-H462-R0-00

PROJECT TECHNICAL REPORT
TASK E-9G

LUNAR FAR SIDE COMMUNICATIONS COVERAGE AND VISIBILITY ANALYSIS FOR SATELLITE RELAY SYSTEMS

NAS 9-8166

5 February 1970

Prepared for
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11176-H467-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROJECT
TECHNICAL REPORT
TASK E-34E

LM-6 LR ALTIMETER BEAM PERFORMANCE NEAR TOUCHDOWN

NAS 9-8166 17 February 1970

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11176-H469-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 FEBRUARY 1970

Prepared for
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11176-H414-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 DECEMBER 1969

Prepared for
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PROJECT TECHNICAL REPORT

APOLLO 10
CSM 106

SERVICE PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166

31 March 1970

Prepared for
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Enclosure to TRW Letter
Task 78

11176-H531-R0-00

PROJECT TECHNICAL REPORT

TASK E-78C

AN EXPERIMENTAL STUDY AND SIMULATION OF THE LM-CSM VHF PCM LINK PERFORMANCE FOR FADING AND NONFADING PROPAGATION CHANNELS

NAS 9-8166

15 April 1970

Prepared for

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11176-H532-R0-00

PROJECT TECHNICAL REPORT

TASK E-9G

LUNAR FAR SIDE COMMUNICATIONS ANALYSIS FOR SATELLITE RELAY SYSTEMS

NAS 9-8166

20 April 1970

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11176-H535-R0-00

SPACECRAFT SYSTEMS ANALYSIS PROJECT

TECHNICAL REPORT

TASK E-34E

APOLLO LUNAR REFLECTIVITY MODEL

NAS 9-8166

29 April 1970

Prepared For

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11176-H549-R0-00

PROJECT TECHNICAL REPORT
TASK E-72B

PRELIMINARY SHUTTLE GN&C SOFTWARE DEVELOPMENT PLAN

NAS 9-8166

22 May 1970

Prepared for
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11176-H555-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 JUNE 1970

Prepared for
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11176-H561-R0-00

Letter # 70.7251-HDF-350
Dat-6-15-70

APOLLO COMMUNICATIONS SYSTEMS

TASK E-59C

TECHNICAL REPORT

ESTL LM PHASE III EXTRAVEHICULAR COMMUNICATION SYSTEM TEST ACCURACY ANALYSIS

NAS 9-8166

15 June 1970

Prepared for

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11176-H525-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 APRIL 1970

Prepared for
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11176-H476-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPOPT

TASK E-34E

A TECHNIQUE FOR COMPUTING DOPPLER VELOCITY SENSOR POWER SPECTRAL DENSITY FOR SPECIFIED TERRAINS

NAS 9-8166

12 February 1970

Prepared For

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11176-H496-R0-00

PROJECT TECHNICAL REPORT

APOLLO 11
LM-5

DESCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166

MARCH 1970

Prepared for
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11176-H497-R0-00

PROJECT TECHNICAL REPORT

TASK E78C

POSTFLIGHT VHF RANGING MULTIPATH ERROR ANALYSIS

NAS 9-8166

2 March 1970

Prepared for

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11176-H498-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION H-2/CSM-109/SPS
PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

March 1970

Prepared for
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11176-H499-R0-00

ANTENNA AND PROPAGATION STUDIES FOR SPACECRAFT SYSTEMS TASK E-53E TECHNICAL REPORT

PREFLIGHT ANALYSIS OF THE LM AND CSM HIGH GAIN ANTENNA SYSTEMS OPERATION ON THE APOLLO 13 MISSION

NAS 9-8166

12 March 1970

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H503-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROJECT

TECHNICAL REPORT

TASK E-34E

ANALYSIS OF LM-7 RENDEZVOUS RADAR RANGE TONES PHASE SHIFT

NAS 9-8166

13 March 1970

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H509-R0-00

PROJECT TECHNICAL REPORT
TASK E-38 C

APOLLO IMU SUMMARY REPORT
VOLUME I

NAS 9-8166

18 MARCH 1970

Transfer No. 70.7254, 3-21
Jack. '38 3-20-70

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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11176-H512-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION H2/LM-7/DPS PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

March 1970

Prepared for
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11176-H515-R0-00

SPACECRAFT SYSTEMS ANALYSIS PROJECT

TECHNICAL REPORT

TASK E-34E

ESTIMATE OF ROUGH TERRAIN CONDITIONS FOR LM-6 BEAM 3 LOCKUP

NAS 9-8166 20 March 1970

Prepared For

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11176-H518-R0-00

PROJECT TECHNICAL REPORT

TASK E-59C

ESTL UP-DATA LINK

PHASE III TEST ACCURACY ANALYSIS

NAS 9-8166

27 March 1970

Prepared for

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11176-H519-R0-00

PROJECT TECHNICAL REPORT

TASK E-78C

APOLLO MISSION H 2
SPACECRAFT TO SPACECRAFT VHF COVERAGE

NAS 9-8166

30 March 1970

TRW Letter No. 72.51-WBW-48
Task-78 3-30-70

Prepared for
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11176-H520-R0-00

ANTENNA AND PROPAGATION STUDIES FOR SPACECRAFT
TASK E-53E
TECHNICAL REPORT

APOLLO 13 MISSION
SPACECRAFT-EVA VHF COVERAGE

NAS 9-8166

31 March 1970

TRW Letter No. 7251.1-920
3-31-70 Task 53 E

Prepared for

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34E

LANDING RADAR LOW ALTITUDE ERROR MODEL

NAS 9-8166

17 February 1970

Prepared For

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11176-H568-R0-00

PROJECT TECHNICAL REPORT

TASK E-78C

SPACE SHUTTLE VHF MULTIPATH ASSESSMENT

NAS 9-8166 30 June 1970

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H565-R0-00

PROJECT TECHNICAL REPORT

USER'S MANUAL FOR COMPUTER PROGRAM HEPCAT

NAS 9-8166

JUNE 1970

Prepared for
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INTERIM PARAMETER SENSITIVITY REPORT OF MISSION E (PRELIMINARY ANALYSIS OF PHASE 6 - SPS MCC, PASSIVE THERMAL CONTROL, AND NAVIGATION SIGHTINGS)

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT - TASK E-74

NAS9-8166

3 SEPTEMBER 1968

Prepared for

National Aeronautics and Space Administration
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11176-6004-R0-00

PROJECT TECHNICAL REPORT

TASK E-70

SIMPLIFIED DYNAMIC ANALYSIS OF APOLLO WATER IMPACT INCLUDING EFFECTS OF THE FLEXIBLE HEAT SHIELD

NAS 9-8166

6 SEPTEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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AN ANALYSIS OF THE APOLLO SPS START TRANSIENT PHENOMENA

1176-6009-R0-00

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11176-6010-R0-00

PRELIMINARY PARAMETER SENSITIVITY REPORT, C PRIME MISSION, HYBRID SIMULATOR REQUIREMENTS

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT - TASK E-74

NAS9-8166

16 OCTOBER 1968

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

TRW SYSTEMS GROUP

NARA SW Box E209H-108

11176-6010-RO-00

PRELIMINARY PARAMETER SENSITIVITY REPORT, C PRIME MISSION, HYBRID SIMULATOR REQUIREMENTS

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NAS9-8166

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Houston, Texas

TRW SYSTEMS GROUP

NARA SW Box E209H-108

11176-6011-R0-00

C PRIME CSM PARAMETER SENSITIVITY ANALYSIS PLAN

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT - TASK E-74

NAS9-8166

16 OCTOBER 1968

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

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NARA SW Box E209H-108

11176-6016-T0-00

PROJECT TECHNICAL REPORT

TASK E-74

C PRIME CSM PARAMETER SENSITIVITY ANALYSIS REPORT TEI AND MCC HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

NOVEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-108

11176-6016-T0-00

PROJECT TECHNICAL REPORT

TASK E-74

C PRIME CSM PARAMETER SENSITIVITY ANALYSIS REPORT
TEI AND MCC
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

NOVEMBER 1968

Prepared for
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MANNED SPACECRAFT CENTER
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11176-6017-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

QUICK LOOK ANALYSIS, C PRIME MISSION, HYBRID SIMULATION RESULTS HYBRID SIMULATION DATA MANAGEMENT SUPPORT

NAS 9-8166

10 NOVEMBER 1968

Prepared for
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MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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CONSTANTS REVIEW
OF
NORTH AMERICAN-ROCKWELL ME-103

HYBRID SIMULATOR DATA MANAGEMENT
SUPPORT - TASK E-74

NAS9-8166 1968 OCTOBER 15

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

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11176-6020-R0-00

PRELIMINARY PARAMETER SENSITIVITY REPORT, D MISSION, HYBRID SIMULATOR REQUIREMENTS

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT - TASK E-74

NAS9-8166

20 NOVEMBER 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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11176-6025-R0-00A

PROJECT TECHNICAL REPORT

TASK E-70A

WATER LANDING CAPABILITY OF THE BLOCK II APOLLO COMMAND MODULE AFT HEAT SHIELD

NAS 9-8166

31 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-108

PARAMETER SENSITIVITY ANALYSIS PLAN

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT - TASK E-74

18 JULY 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

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11176-6039-RO-00

MASS PROPERTIES CONSTANT REVIEW

NORTH AMERICAN ROCKWELL ME-104 (D)

HYBRID SIMULATOR DATA MANAGEMENT

SUPPORT - TASK E-74

NAS9-8166

17 FEBRUARY 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NARA SW Box E209H-109

11176-6043-R0-00

CONSTANTS REVIEW

NORTH AMERICAN ROCKWELL ME-106(F)

HYBRID SIMULATOR DATA MANAGEMENT

SUPPORT - TASK E-74

NAS9-8166

18 MARCH 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209H-109

11176-6045-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

FINAL PARAMETER SENSITIVITY ANALYSIS REPORT CSM-MISSION F

NAS9-8166

27 MARCH 1969

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

Prepared by

Guidance System Engineering Department
G&N Laboratory

NARA SW Box E209H-109

TRW

11176-6051-R000

TASK ASPO-80

Apollo/Saturn Explosive Hazard Study

Final Report

2 May 1969

Prepared Under Contract No. NAS9-8166 For

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

Prepared by J. M. Allison
J. M. Allison
Member Professional Staff

Approved by J. M. Bourgeois
for J. B. Peterson, Head
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Approved by F. C. Loesch
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11176-6056-R0-00

CONSTANTS REVIEW

NORTH AMERICAN ROCKWELL ME-107(G)

HYBRID SIMULATOR DATA MANAGEMENT

SUPPORT - TASK E-74

NAS9-8166

16 JUNE 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by

R. I. Rosen

NARA SW Box E209H-109

11176-6068-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO 73C

LUNAR SURFACE EROSION DURING APOLLO 11 LANDING

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Houston, Texas

November 20, 1969

TRW SYSTEMS GROUP
One Space Park, Redondo Beach, California

NARA SW Box E209H-109

11176-6031-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

CSM-104 D MISSION QUICK LOOK ANALYSIS
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS9-8166

11 JANUARY 1969

PREPARED FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

PREPARED BY
GUIDANCE SYSTEM ENGINEERING DEPARTMENT
G&N LABORATORY

NARA SW Box E209H-109

File

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY STATUS REPORT

ASPO TASK 10

DFI GSE AND GROUND TEST VEHICLES STUDY

2241-H007-SU000

15 December 1965

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas
Under
Contract No. NAS9-4810

TRW SYSTEMS GROUP
TRW Inc.
Space Park Drive, Houston, Texas

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 28

LEM LANDING RADAR ENGINE PLUME

EFFECTS STUDY

2242-H001-TO-000

1 April 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas
Under
Contract No. NAS9-4810

Prepared _____
E. J. Rood

Approved _____
John DeVillier
Manager
Apollo Communications
Project Office

TRW SYSTEMS
Space Park Drive · Houston, Texas

NARA SW Box E209H-10

2242-6001-RU000

LEM RENDEZVOUS RADAR ANGLE MEASUREMENT INACCURACY DUE TO MULTIPATH AND VARIABLE POLARIZATION

Contract No. NAS9-4810

20 OCTOBER 1965

Prepared for
MANNED SPACECRAFT CENTER
Houston, Texas

BM-86

*68-19195

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 28
LEM LANDING RADAR ENGINE PLUME EFFECTS STUDY

2242-6002-T0000 1 January 1966

Prepared for

NASA MANNED SPACECRAFT CENTER
Houston, Texas

Under

Contract No. NAS9-4810

Prepared _____
R. N. Fenton

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J. E. Holland, Manager
Guidance Sensors Department

TRW SYSTEMS

NARA SW Box E209H-10

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 28
LEM LANDING RADAR ENGINE PLUME EFFECTS STUDY

2242-6003-R0000

1 February 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas

Under
Contract No. NAS9-4810

Prepared: R N Fenton

R. N. Fenton
Task Manager

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J. E. Holland, Manager
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 28
LEM LANDING RADAR ENGINE PLUME EFFECTS STUDY

2242-6004-R0000

1 March 1966

Prepared for

NASA MANNED SPACECRAFT CENTER
Houston, Texas

Under Contract No. NAS9-4810

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NARA SW Box E209H-10

MICROFICHE DOCUMENT IDENTIFICATION LABEL

TYPE ALL ENTRIES

(See instructions on reverse side)

1. MSC ACCESSION NUMBER *(For BM61 Use Only)*	2. DOCUMENT OR CORPORATE SOURCE REPORT NUMBER	3. DOCUMENT OR REPORT TITLE
*69-25515	2242-6005-R0000	LEM Landing Radar Engine Plume Effects
	DOCUMENT OR REPORT TITLE (CONTINUED)	Study (ASPO Task 28) Monthly Progress Rept. (For Period of March 1966)
4. MSC ORIGINATING OFFICE CONTROL NUMBER	5. CORPORATE SOURCE	
BM86	TRW Systems/Houston	

6. SPONSORING-MONITORING AGENCY AND RELATED REPORT RELATED REPORT NUMBER	7. PRIMARY PERSONAL AUTHOR	8. CONTRACT NUMBER
		NAS 9-4810

9. SECURITY CLASSIFICATION	10. FOREIGN LANGUAGE TITLE	11. NUMBER OF PAGES	12. REPORT DATE	13. DISTRIBUTION CODE
			April 1, 1966	

14. REMARKS:

Return this hard copy to BM86 by August 1, 1969.

MSC Form 1928 (May 67)

NASA MANNED SPACECRAFT CENTER

Houston, Texas

Under Contract No. NAS9-4810

Prepared R. N. Fenton

R. N. Fenton
Task Manager

Approved J. E. Holland

J. E. Holland, Manager
Electromagnetic and Acoustic
Sensors Department

*69-25515 BM86

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

FINAL REPORT

ASPO TASK 28
LEM LANDING RADAR ENGINE PLUME EFFECTS STUDY

2242-6006-R0000 15 April 1966

Prepared for

NASA MANNED SPACECRAFT CENTER
Houston, Texas

Under Contract No. NAS9-4810

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Approved J. E Holland

J. E. Holland, Manager
Electromagnetic Acoustic
Sensors Department

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ASPO
Files

APOLLO SPACECRAFT

SYSTEMS ANALYSIS PROGRAM

CSM 009

ASPO TASK 29

ACCURACY ANALYSIS OF APOLLO OPERATIONAL INSTRUMENTATION

7 FEBRUARY 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas

Under
Contract No. NAS9-4810

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NARA SW Box E209H-10

APOLLO SPACECRAFT

SYSTEMS ANALYSIS PROGRAM

CSM 011

ASPO TASK 29

ACCURACY ANALYSIS OF APOLLO OPERATIONAL INSTRUMENTATION

7 MARCH 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas

Under
Contract No. NAS9-4810

TRW SYSTEMS

NARA SW Box E209H-10

2243-H003-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO 29

ACCURACY ANALYSIS OF THE APOLLO OPERATIONAL INSTRUMENTATION

27 MAY 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

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2251-H003-R0-000
66.3345, C-2

PROGRAM TECHNICAL REPORT
TASK ASPO-17-6

INTERIM REPORT NO. 2
STRUCTURAL DYNAMICS CHARACTERISTICS DOCUMENT

NAS 9-4810

1 JUNE 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NARA SW Box E209H-10

2251-H004-R0-000

PROGRAM TECHNICAL REPORT

TASK ASPO-39

SERVICE MODULE - SPACECRAFT LM ADAPTER INTERFACE STRENGTH CAPABILITY BLOCK I

NAS 9-4810

1 JULY 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-10

2241-H005-SU000

MONTHLY STATUS REPORT

for the Study of

DFI GSE AND GROUND TEST VEHICLES

15 NOVEMBER 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

TASK MSC/TRW ASPO-10

Contract NAS9-4810

TRW SYSTEMS GROUP

NARA SW Box E209H-10

66:7224.2.8-10

LUNAR DESCENT SIMULATION RESULTS
REPORT NO. 1

17 AUGUST 1966

Prepared by
C. G. Brockus

TRW SYSTEMS

NARA SW Box E209H-110

66:7224.2.8-12
(Supplement)

LUNAR DESCENT SIMULATION RESULTS
REPORT NO. 3 (SUPPLEMENT)

2 SEPTEMBER 1966

Prepared by
C. G. Brockus

TRW SYSTEMS

NARA SW Box E209H-110

66:7224.2.8-12

LUNAR DESCENT SIMULATION RESULTS
REPORT NO. 3

31 AUGUST 1966

Prepared by
C.G. Brockus

TRW SYSTEMS

NARA SW Box E209H-110

66.7224.2.8-13

LUNAR DESCENT SIMULATION RESULTS
REPORT NO. 4

1 SEPTEMBER 1966

Prepared by
C. G. Brockus

TRW SYSTEMS

NARA SW Box E209H-110

BLOCK II COMMAND MODULE LAND LANDING

STRUCTURAL CAPABILITY ANALYSIS

TASK ASPO 5A

1 November 1967

67.3302.0-71

Prepared by: W. J. Dean
R. M. Kurland
A. H. Mactavish
R. C. Wendt

Approved by: S. Lutwak

S. Lutwak, Manager
Structures Department

Approved by: A. J. Rinaldi

A. J. Rinaldi, Manager
Apollo Engineering Operations
Department

NARA SW Box E209H-110

TRW SYSTEMS

INTEROFFICE CORRESPONDENCE 67.3302.3-13

TO: A. J. Rinaldi CC: See Distribution DATE: 10 July 1967

SUBJECT: CSM/LM Three Dimensional Modes for Full Weight Condition

*70-28234

EXT. 2893/2883

Reference: 1) ASPO Task 39B - Apollo Spacecraft Structures and Dynamic Analysis, 15 March 1967.

2) TRW Memorandum 67.3302.3-6, "AS-258A Configuration Three Dimensional Modes", by A. Bedford and A. Goldberg, 19 April 1967.

3) TRW Report 05952-H239-R000, "Three Dimensional Vibrational Modes of the Apollo CSM/LM Docked Vehicle", by A. Bedford and A. P. Goldberg, 30 June 1967.

Introduction

Three dimensional vibration modes of the CSM/LM docked spacecraft for the full weight condition have been computed. The frequency and deflection data are documented here as part of the task requirements outlined in Reference 1.

Discussion

The mode data for the fully loaded CSM/LM vehicle are derived from the same stiffness model used in the quarter-full modes of Reference 2. The mass data are also identical except for those points in the model representing the SPS propellant tanks. Since the full loaded tanks are not expected to have any appreciable sloshing, the modes were computed with no adjustment in the fluid masses for sloshing effects. A summary of the total mass properties for the CSM and CSM/LM are presented in Table 1. Details on the stiffness model are presented in Reference 3. The mode shapes are tabulated in Table 2 and the mode frequencies are presented in Table 3. The geometric location of the nodes are presented in Table 4, with the x, y, z axis system being the standard Apollo coordinate system. The LM node numbers have been transformed to the Apollo system for docked configurations. The deflection data of Table 2 are presented by ascending mode number. Within each mode the translational deflection components are tabulated first and the rotational components last in sequential order of node number. If a blank space occurs in the data then it means those particular components were not

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PREFLIGHT HEAT SHIELD TEMPERATURE PREDICTIONS FOR APOLLO MISSION AS-501

Task ASPO-45

Thermal Protection System Performance Evaluation

67.3302.7-6

24 May 1967

Prepared by: R. G. Posgay

Approved by: R. G. Payne, Assistant Manager
Apollo Engineering
Operations Department

Approved by: Donald M. Curry
MSC Task Monitor
Structures and Mechanics Division
Thermo-Structures Branch

NARA SW Box E209H-110

TRW

INTERCOFFICE CORRESPONDENCE

V. R. Widerquist

67-3340.4-35
DATE 20 November 1967

Comparison of Theory with Surface Pressure Data Obtained by Firing the Apollo RCS Engine onto Flat Plates

R. E. Hutton
R1 1004 63610

References: (1) LM-RCS Engine Test Data--Data provided by MSC to TRW during ASPO Task 47.

(2) Leonard Roberts, "The Action of a Hypersonic Jet on a Dust Layer," IAS Paper No. 63-50, January 21-23, 1963.

*70-28233

I. SUMMARY

Comparisons were made of theoretical surface pressure with that measured during RCS Engine firings. The comparison indicated theory provided an engineering estimate of pressure for nozzle heights greater than the critical height defined by Roberts. For lower nozzle heights the local theoretical pressure deviated substantially from measured pressure. One of the primary differences was that the surface pressure distribution deviated from a typical bell-shape and the surface pressure directly below the jet was less than the pressure at neighboring points. This effect was probably due to the formation of oblique shock waves upstream of the surface shock. Roberts' theory does not take such shocks into consideration and therefore predicts a bell-shaped surface pressure whose maximum always occurs directly below the jet (the stagnation point).

II. INTRODUCTION

Tests[1] were conducted with the Apollo RCS Engine by live firings in a vacuum chamber at the Langley Research Center by a joint effort of MSC and LRC. Part of the data taken during these tests consisted of pressures measured on a flat plate located below the RCS Engine. Measurements were made for various nozzle heights, thrust levels and plate orientations. Plate orientations consisted of 0, 4, 8 and 12 degree angles between the plate and nozzle exit planes.

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NARA SW Box E209H-110

TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

67.4711.7-119

TO: A. R. Palmer CC: Distribution DATE: 16 November 1967

SUBJECT: Preliminary Apollo 4 Propellant Density Estimates FROM: R. J. Smith
BLDG H-3 ROOM 2065D EXT. 2833

---

ence 1) AFBSD-TR-62-2 "TITAN II Storable Propellant Handbook," Bell Aerosystems Co., March 1962.

NASA/MSC has received some Apollo 4 propellant density data from KSC which are used herein to arrive at preliminary estimates of the SPS densities to be used in the Apollo 4 evaluation.

OXIDIZER DENSITY EQUATION

An N_2O_4 density measurement taken on 12 October 1967 yielded a value of 1.4823 gm/ml (92.537 lbm/ft^3) at 39.2°F. Conflicting information received later, however, indicated that the 12 October value may have been for the RCS oxidizer supply. Eight samples measured during S/C servicing yielded the following values at 39.2°F.

	1.4827	gm/ml
	1.4828	
	1.4829	
	1.4829	
	1.4830	
	1.4831	
	1.4831	
	1.4832	gm/ml
mean	1.4830	gm/ml (92.581 lbm/ft^3)

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NO

Again, however, there is some question as to which of these eight samples were from the SPS supply and which were from the RCS supply. Since the 12 October value falls outside the range of the eight later values, and the RCS and SPS values are mixed, the mean value of the eight later measurements was used in this analysis. The intercept of the Titan N_2O_4 density equation (Reference 1) was adjusted so that the equation would yield 92.581 lbm/ft^3 at a temperature of 39.2°F and at a pressure of 14.7 psia. The adjusted density equation, recommended for use in the Apollo 4 evaluation, is;

NARA SW Box E209H-110

"SUMMARY OF APOLLO MISSION AS 503 CM ECS RADIATOR LOOP AND HEAT SHIELD THERMAL ANALYSIS"

TASK ASPO 12

LUNAR MISSION PERFORMANCE VALIDATION

16 September 1966

66.3345.4-6

Prepared by: E. G. PAYNE

TRW SYSTEMS
Space Park Drive
Houston, Texas

NARA SW Box E209H-110

APOLLO MISSION TECHNIQUES

(CHAPTER IV LUNAR DESCENT)

16 OCTOBER 1967

Prepared for
NASA Data Priority Study Group

*70-28232

WORKING PAPER

MANNED SPACECRAFT CENTER
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NARA SW Box E209H-111

PRELIMINARY STRUCTURAL ANALYSIS OF THE COMMAND MODULE BLOCK II AFT HEAT SHIELD FOR UNIFORM, RAMP AND COLISEUM WATER PRESSURE DISTRIBUTIONS - ADDENDUM A

TASK E-70

COMMAND MODULE WATER AND LAND LANDING
STRUCTURAL CAPABILITY ANALYSIS

27 March 1968

68.3302.0-17A

Mostek

*70-2823C

Prepared by: W. J. Dean
R. S. Wolf

Approved by: S. Lutwak
S. Lutwak, Manager
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Approved by: A. J. Rinaldi
A. J. Rinaldi, Manager
Apollo Engineering Operations
Department

TRW SYSTEMS GROUP

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NARA SW Box E209H-111

LOADS ANALYSIS

CREW COMPARTMENT HEAT SHIELD/SIDEWALL

TASK E-70

COMMAND MODULE WATER AND LAND LANDING
STRUCTURAL CAPABILITY ANALYSIS

11 March 1968

68.3302.0-25

* 70-25236

Prepared by: R. J. Herring
R. C. Wendt

Approved by: A. J. Rinaldi

A. J. Rinaldi, Manager
Apollo Engineering Operations
Department

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VANGUARD BLDG.
RECORD COPY

YES ✓
NO

NARA SW Box E209H-111

PRELIMINARY BLOCK II COMMAND MODULE AFT BULKHEAD STRUCTURAL CAPABILITY ANALYSIS

TASK E-70

COMMAND MODULE WATER AND LAND LANDING
STRUCTURAL CAPABILITY ANALYSIS

68.3302.0-38

12 April 1968

Prepared by: R. M. Kurland

Approved by: S. Lutwak
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Approved by: A. J. Rinaldi
A. J. Rinaldi, Manager
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Department

TRW SYSTEMS GROUP

NARA SW Box E209H-111

INTERIM REPORT ON THE DEVELOPMENT OF A SIMPLIFIED DYNAMIC ANALYSIS OF APOLLO WATER IMPACT INCLUDING EFFECTS OF THE FLEXIBLE HEAT SHIELD

TASK E-70

COMMAND MODULE WATER AND LAND LANDING STRUCTURAL CAPABILITY ANALYSIS

15 MAY 1968

68.3302.0-47

Prepared by: A. Kaplan

Approved by:

A. J. Rinaldi, Manager
Apollo Engineering Operations
Department

TRW SYSTEMS GROUP

NARA SW Box E209H-111

SPACECRAFT 009 COMMAND MODULE (+)Z CORNER

LAND IMPACT STRUCTURAL ANALYSIS

Task E-70

COMMAND MODULE WATER AND LAND LANDING
STRUCTURAL CAPABILITY ANALYSIS

27 March 1968
68.3302.9-1

Prepared by

E. M. Huacuja

Approved by: G. E. A. Thomann

G. E. A. Thomann, Head
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Approved by: A. J. Rinaldi

A. J. Rinaldi, Manager
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NASA CR-98252

TRW SYSTEMS GROUP
ONE SPACE PARK
HOUSTON, TEXAS

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NARA SW Box E209H-111

TRW SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE

68.3302.10-6

TO: Task E-66 File CC: DATE: 7 March 1968

SUBJECT: AS-201 Predicted and Measured Entry Heat Rates

FROM: B. B. Harmel
BLDG H-3 MAIL STA. 2095 EXT. 2898

References: (1) "Revisions to the STAB II Charring Ablation Program", TRW IOC 68.3302.2-1, by H. H. Battley, 18 January 1968.

(2) "Entry Heat Transfer and Pressure Measurements of the Command Module for the Apollo-Saturn 201 Mission", by Dorothy B. Lee and John J. Bertin, NASA/MSC Report No. S-159, September, 1967 (unreleased).

(3) "Program F144 - Apollo Heating Rates", NASA/MSC Project No. 3341, by Bernard F. Stuckey, 19 January 1966.

(4) "Computer Programs for Asymptotic Calorimeters", TRW IOC 68.3324.2-5, by Alan Burbank, 5 January 1968.

(5) "The Effect of Discontinuous Mass Injection on Apollo Heat Transfer Measurements", TRW IOC 68.3324.2-23, by Alan Burbank, 2 February 1968.

Enclosed are the results of an analysis of the aerodynamic heating rates to selected body locations on the conical heat shield of S/C 009 during entry. This analysis was performed using the MSC F144 program (Reference 3) to calculate predicted cold wall heating rates to the vehicle reference point (S/R = 0, α = 0) for the AS-201 entry trajectory that is defined in Reference 2. These cold wall heating rates, the trajectory, and the appropriate body point data (Table 1) were input to the most recent version of the Standard Ablation Program (STAB II) to obtain the predicted heating rates (with blowing) to selected heat shield locations. This recent version of STAB II has, in addition to the revisions discussed in Reference 1, a new surface recession model which defines the surface chemical reactions more adequately. This analysis also included a study of the effect of varying the turbulent flow model on the windward conic heat shield from a sphere (shape factor = .055) to a flat plate (shape factor = .085). On the leeward toroid section of the heat shield, a comparison of local heating rates was made considering both separated and attached flow.

The results of the analysis are compared to the measured heat rates which have been corrected for the following:

1. Re-calibration errors (5% for zirconia ring and surface emittance changes).

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TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

68.3302.10-9

TO: Task E-66 File CC: DATE: 21 March 1968

SUBJECT: Preflight Predictions of AS-502 Entry Heating Rates

FROM: B. B. Harmel
BLDG. H-3 ROOM 2095 EXT. 2898

References: (1) "Revisions to the STAB II Charring Ablation Program", TRW IOC 68.3302.2-1, by H. H. Battley, 18 January 1968.

(2) "Program F144 - Apollo Heating Rates", by Bernard F. Stuckey, NASA/MSC Project No. 3341, 19 January 1966.

(3) "Apollo Command Module (CM) Entry Air Radiation Heating Rates", by Robert C. Ried, Jr., NASA/MSC Memorandum ES5/1-9/6M, 9 January 1968.

Enclosed are the results of the AS-502 preflight analysis of the heating rates to the S/C 020 heat shield during entry. This analysis was performed using the MSC developed F144 aerodynamic heating program (Reference 2) to calculate the cold wall heating rates to each body location and the most recent version of the Standard Ablation Program (Reference 1) to calculate the net heating rates to selected calorimeter locations. In addition to the revisions discussed in Reference 1, the STAB II program used includes an updated surface recession model which more adequately defines the chemical reactions occurring at the ablator surface.

The AS-502 nominal trajectory (L/D = .338, γ = -6.5, Range = 2500 nm), as presented in Figure 5, and the appropriate data for each body point were input to the F144 program to calculate the cold wall heating rates to all calorimeter locations on the S/C 020 heat shield as well as one lee side window location and the heat shield reference point (S/R = .9875, α = 22.5). The radiation heating rates to the reference point during AS-502 re-entry were obtained from the tables provided in Reference 3. The cold wall heating rate and the radiation heating rate to the heat shield reference point (S/R = .9875, α = 22.5°), the AS-502 nominal trajectory, and the appropriate data for each of the ten heat shield locations analyzed, were input to the Standard Ablation Program (STAB II) and the net heating rate was determined to the ablator surface at each point.

Figure 1 presents the total and net heat rates, as predicted by the STAB II program, to four calorimeter locations on the aft heat shield. Figure 2 presents the cold wall heating rates, as predicted by the F144 program, to the remaining six calorimeter locations on the aft heat shield. Figure 3 presents the total and net heat rates, as predicted by the STAB II program, to six calorimeter locations on the conical portion of the heat shield.

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TRW

68.3302.11-5
Re: Task E-67

31 May 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. S. Jacobs, ES12

Subject: Submittal of Project Technical Report, "TRW SESL Chamber A Thermal Environment/2TV-1 Spacecraft Computer Program, Volume II, User's Manual"

Gentlemen:

Enclosed is the subject TRW Project Technical Report No. 05952-H516-R0-00 which presents the complete operating requirements, systems information, input data format, source language listings, and a sample case for the TRW SESL Chamber A Thermal Environment/2TV-1 Spacecraft Computer Program. The technical report transmitted herewith completes Objective (1) of Task E-67.

The TRW SESL Chamber A Thermal Environment/2TV-1 Spacecraft Computer Program was developed to provide a rapid means of describing the thermal environment to the 2TV-1 spacecraft during thermal tests or for pre-test calculations.

Volume I of the subject report (Engineering Description) which was transmitted on 8 March 1968 contains the computer program requirements, the mathematical model, the input information and the overall programming aspects in the engineering sense.

The computer program has undergone checkout which includes Spacecraft 2TV-1 pre-test thermal environment predictions. The program will also accept the actual RIMS (Radiation Intensity Measurement System) data and simulate the thermal environment to the 2TV-1 Spacecraft for the 2TV-1 thermal tests.

Very truly yours,

TRW SYSTEMS GROUP

R. R. McMurchy

R. R. McMurchy, Manager
Task E-67

H. I. Leon

H. I. Leon, Manager
Apollo Engineering Analysis Project

RRM:djr
Enclosure

NARA SW Box E209H-111

REVIEW OF

LANDING GEAR STRESS ANALYSIS

REVISION A

TASK E-5B

PROBLEM AREA IDENTIFICATION

18 March 1968
68.3302.12-2A

Prepared by: R. J. Herring
R. J Herring

Approved by: G. E. A. Thomann
G. E. A. Thomann

TRW SYSTEMS
ONE SPACE PARK
HOUSTON, TEXAS

NARA SW Box E209H-111

REVIEW OF
LM LANDING GEAR CERTIFICATION
DROP TEST RESULTS

68.3302.12-5
Task E-5B
19 March 1968

Prepared by: R. J. Herring
R. J. Herring

Approved by: G. E. A. Thomann
G. E. A. Thomann, Head
Structures Section

TRW SYSTEMS GROUP
ONE SPACE PARK
HOUSTON, TEXAS

NARA SW Box E209H-111

LANDING GEAR DROP TEST REVIEW

TASK E-5B

PROBLEM DEFINITION AND SPECIAL STUDIES

17 April 1968

68.3302.12-6

Prepared by: R. J. Herring

Approved by: G. E. A. Thomann

G. E. A. Thomann, Head
Structures Section
Apollo Engineering Operations
Department

Approved by: A. J. Kinaldi

A. J. Kinaldi, Manager
Apollo Engineering Operations
Department

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INTEROFFICE CORRESPONDENCE

68.3302.16-6

TO: Task E-66 File CC: See Distribution DATE: 25 March 1968

SUBJECT: S/C 017 Asymptotic Calorimeter Temperature Analysis

FROM: W. C. Rochelle
BLDG H3 MAIL STA. 2085 EXT. 2869

This memorandum presents results of an in-depth temperature analysis of four asymptotic calorimeters, CA 5550R, CA 5556R, CA 5560R, and CA 5563R for the Apollo 017 Spacecraft during the AS-501 entry. This analysis is required to support subsequent analyses of non-isothermal wall corrections and discontinuous mass injection studies. The temperatures of the constantan sensor, copper heat sink, zirconia insulating material, and surrounding Avcoat 5026-39-HCG ablator were determined using the corresponding local uncorrected heating rates and extrapolated values of ablator surface temperatures. A discussion of the calorimeter thermal model used with the TRW Thermal Analyzer Program (TAP) is presented along with calculated temperatures on (or near) the various asymptotic calorimeters.

There were twenty-one asymptotic calorimeters mounted on the S/C 017 command module conical heat shield. These were steady-state sensors which measured heating rates directly as a function of time (Reference 1). However, because of the large temperature difference existing between the center of the constantan sensing foil and the surrounding heat shield ablator, the heating rates recorded by the sensor were not the same as those which would be obtained if the entire surface were an ablator. Heating rate corrections for the S/C 017 asymptotic calorimeters were previously obtained for approximate sensor and sink temperatures by using the wall temperature discontinuity methods (References 2 through 4) and also by discontinuous mass injection methods (Reference 5). These results will be modified by using the temperatures calculated by this analysis.

The thermal model used for the asymptotic calorimeters is presented in Figure 1. The temperatures for this model were calculated by means of the TRW Thermal Analyzer Program discussed in References 6 and 7. This program uses an explicit forward difference numerical integration technique based on an electrical circuit analogy. In this program all of the equations and descriptive expressions are given as functions of resistance, capacitance (equal to the product of density, volume, and specific heat of material), temperature, and heating rate. The measured uncorrected heating rates to the calorimeter were used as the driving potential with the reradiation from the sensor assumed negligible because of the low constantan temperatures (very small change in net heating rate). An extrapolation of measured in-depth heat shield ablator temperatures (at thermocouple locations of 0.5 in., 0.20 in., 0.40 in., and at the bondline) was used to provide an input of temperature history as a function of time for the ablator surface, node 8. These thermocouple-in-depth extrapolations included

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TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

68.3302.17-2

TO: Task E-70 File CC: DATE: 15 March 1968

SUBJECT: Vehicle Configuration for S/C 2S-1 (S/C 099) FROM: R. C. Wendt

BLDG H3 ROOM 2096 EXT. 2895

This memo is prepared for the purpose of delineating certain vehicle configuration requirements for the land and water impact test vehicle, S/C 2S-1 (S/C 099). While it is conceded that some of the listed items are intuitively obvious, all are sufficiently significant to warrant specific reference and their exclusion will substantially limit the validity of subsequent tests.

Water Impact Vehicle Configuration Requirements

1. Have spacecraft seals around all penetrations, especially around the forward hatch.

2. Have cabin pressure relief valve installed and in a closed position.

3. Have TG15000 insulation material installed between the aft bulkhead and aft heat shield for all low angle tests.

4. Have adequate simulation of all large boxes installed with proper attachments on the aft bulkhead, e.g., CO_2 absorber containers, etc.

5. Have astro-sextant mechanism installed, along with the passive thermal protection system.

6. Have adequate simulation of all Earth Land System (ELS) and up-righting system equipment installed in the +Z quadrant of the apex region.

7. Have re-designed fiberglass fairings (e.g., V36-316131, V36-316123, etc.) installed in +Z quadrant of apex region.

8. Have up-righting system operatable for a check of the system, if the vehicle should be in a stable II flotation position following the impact test.

9. Have a vacuum drawn on the vehicle at the time of impact to simulate the cabin pressure relief valve lag characteristics and the effect of closing the valve at some altitude prior to splash-down.

*70-28254

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Yes ✓
NO

SYSTEMS 180 REV. 7-65

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SIMPLIFIED DYNAMIC ANALYSIS OF QUARTER SCALE WATER IMPACT MODEL

TASK E-70

COMMAND MODULE WATER AND LAND LANDING STRUCTURAL CAPABILITY ANALYSIS

8 May 1968

68.3302.18-6

Prepared by: H. G. Schaeffer

Approved by: A. P. Goldberg
A. P. Goldberg, Head
Dynamics Section
Apollo Engineering
Operations Department

Approved by: A. J. Rinaldi
A. J. Rinaldi, Manager
Apollo Engineering Operations
Department

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INTEROFFICE CORRESPONDENCE

TO: Task E-66 File

P. B. Brandt PBB
W. C. Rochelle
B. B. Harmel
R. G. Posgay

DATE: 8 March 1968

SUBJECT: Calorimeter Correction Factor for Flight 201

FROM: A. Burbank A. B.
BLDG. R4 MAIL STA. 1166 EXT. 63955

References: 1) Woodruff, Hearne, and Keliher, "Interpretation of Asymptotic Calorimeter Measurements," AIAA Journal, Vol. 5, No. 4, April 1967, pp 795.

2) Burbank, A., "Computer Programs for Asymptotic Calorimeters," TRW IOC 68-3324.2-5, 5 January 1968.

Correction factors were calculated for the asymptotic calorimeter located near the windward meridian at x = 11.36 ft. on Flight 201. This correction factor ($\dot{q}_{upstream}/\dot{q}_{measured}$) is given as a function of time on Figure 1. Calculations were made with the "NIW" Program using the methods of References 1 and 2. This calorimeter data correction is due to the large drop in surface temperature between the nearby upstream surface, and the calorimeter surface, as shown on Figure 2. The local upstream surface temperatures were calculated with the STAB II Program driven by the measured heat flux minus an estimated 10% reduction due to nonisothermal effects. The temperatures at the calorimeter base (foil edge) were taken from a TAP analysis of calorimeter 5550 on Flight 501 because the heating rates were about the same and both calorimeters were the same type (50 Btu/ft^2-sec maximum). This assumption is quite adequate because the solution is not very sensitive to an exact knowledge of the precise base temperature, although the general level of the base temperature must be known.

NARA SW Box E209H-111

31 January 1968 68-3340.4-2

LM SOIL EROSION HAZARDS AS IMPLIED BY SURVEYOR VI SOIL EROSION RESULTS

by

R. E. Hutton

TRW SYSTEMS GROUP

NARA SW Box E209H-111

No. 68-3343-27

PRELIMINARY REPORT OF THE APOLLO SATURN SPACE VEHICLE POGO ANALYSIS

Prepared by:

TRW Systems Group

July 8, 1968

Approved by: Abner Rasumoff

Abner Rasumoff
TRW Task Manager

NARA SW Box E209H-111

TRW SYSTEMS

INTEROFFICE CORRESPONDENCE 68-3346.11-13

TO: H. I. Leon

CC: J. Coffman
H. Harris
R. Payne

DATE: 26 March 1968

SUBJECT: Thermal Control Sample Handling - CSM 103/LM3

FROM: E. E. Luedke

BLDG. R4 ROOM 2012 EXT. 66831

Reference: TRW IOC 67-3302.8-1, "Guidelines for Handling and Installation of Thermal Control Test Specimens on AS 258" from H. J. Harris to H. I. Leon, dated 20 January 1967.

CSM 103/LM3 mission objective P 17.10 calls for the recovery of thermal control and optical materials samples from the exterior of the CSM and LM during EVA. The effort involved in the sample recovery portion of this task can be divided into three phases:

I. Ground Handling - Pre-Flight
   a) Sample preparation
   b) Mounting provisions
   c) Protection prior to installation
   d) Measurement of thermal properties
   e) Installation of samples on vehicle

II. Flight Handling
   a) Removal during EVA
   b) Transfer into spacecraft
   c) Storage

III. Ground Handling - Post-Flight
   a) Remove container from CM
   b) Transfer to TRW
   c) Measurement of thermal properties
   d) Transfer to MSC for further analysis

Due to the requirement for timely EVA procedures, the recommended flight handling procedures are included as an attachment to this memorandum. The recommended ground handling procedures will be completed within two months. The reference document presents preliminary information on ground handling requirements. The flight handling procedures are based on thermal sample handling requirements as follows:

1. The sample surfaces must not be touched at any time.
2. The samples should not be exposed to the cabin environment without some means of protection. The sample storage container, while not pressure sealed, has a vapor barrier which

NARA SW Box E209H-111

LM RCS PLUME IMPINGEMENT STUDY

FINAL REPORT

Prepared

by

W. C. Rochelle

68.3352.16-26 19 December 1968

Approved by:

R. R. McMurchy, Head
Heat Transfer Section

R. G. Payne, Manager
Thermodynamics Department

NARA SW Box E209H-111

67-7-13

MK
Mit

67:7224.8-67

TASK MSC/TRW A-97

PRELIMINARY INDEPENDENT FLIGHT SOFTWARE VALIDATION TEST RESULTS FOR LM-1 MISSION

30 June 1967

Prepared By:

C. W. Clark

J. R. Henson

J. B. Hill

Approved By: W. J. Klenk

W. J. Klenk
Assistant Manager for Software
Guidance & Control Department

NARA SW Box E209H-111

TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

TO: D. W. Vernon

CC: Distribution

68.4711.7-147
DATE: 22 February 1968

SUBJECT: DPS SVEAD Model Status

FROM: A. T. Funada
BLDG. H3 ROOM 2064 EXT. 2133

This memorandum presents a set of equations for each of the DPS models currently in use, as well as an index of variable names. Currently in use are three (3) different engine models. They are, ullage pressure driven model, interface pressure driven model, and standard inlet condition model. The index of variable names is presented SVEAD Program value array numerical order, and in variable name alphabetical order.

The set of state variables selected for these engine models are as follows:

1) Oxidizer weight, tank #1 (WO1)
2) Oxidizer weight, tank #2 (WO2)
3) Fuel weight, tank #1 (WF1)
4) Fuel Weight, tank #2 (WF2)
5) Percent throat erosion (A)
6) Oxidizer ullage or interface pressure bias (BPOU, BPIO)
7) Fuel ullage or interface pressure bias (BPFU, BPIF)
8) Throttle actuator voltage bias (BVA)
9) Miscellaneous Weight (WMIS)
10) Thrust coefficient bias (CFB)

ATF:bm

Enclosure.

Distribution

J. P. Aha
E. Joseph
C. S. Powers (2)
R. K. M. Seto
R. J. Smith

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YES ✓
NO

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TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

TO: John P. Aha CC: Distribution

68.4711.8-69
DATE: February 26, 1968

T: Impulse Due to FITH ABORT SEQUENCE

FROM: R. K. M. Seto
BLDG. H3 ROOM 2077 EXT. 2830

The enclosed study analyzes the impulse given to the ascent stage attributed to the "open breech" effect occurring during the FITH abort. The analysis is based on ΔV data from measurement number GG 0001X gathered during DPS 2, DPS 3/APS 1 and APS 2 burns. It was calculated that an impulse of 661 ± 200 lb-sec occurred at spacecraft separation.

RKMS:bm

Distribution
D. W. Vernon
R. J. Smith
B. T. Hogan
W. W. Martin
D. G. Saile
B. B. White
J. M. McCurry

Approved: John P. Aha
Performance Analysis Section

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YES ✓
NO

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TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

68.4711.8-93

TO: D. W. Vernon CC: DATE: 28 March 1968

SUBJECT: DPS Engine Performance at the Specification Limits of Operation

FROM: R. K. M. Seto
BLDG. H3 ROOM 2077 EXT. 2830

Reference: GAEC DPS Engine Specification, LSP-270-2B.

Enclosed is a brief study to determine the lowest expected DPS engine performance when the system is operating with the worst combination of engine interface conditions within their allowable limits as presented in the engine specification (Reference). The study was conducted for a typical lunar mission duty cycle (LMDC) assuming the current LM-3 spacecraft weights and a modified LM-1 DPS engine (S/N 1026).

Even though the results are generally favorable, it should be realized that the probability of the combination of study conditions is rather remote, such that the study might be considered a worst case.

Approved: _____
John P. Aha, Head
Performance Analysis Section

RKMS:bm

Enclosure

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YES ✓
NO _____

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TRW SYSTEMS

4-2-21

INTEROFFICE CORRESPONDENCE

68.4711.8-98

TO: B. C. Hopkins

CC: B. R. Ellison
D. W. Vernon

DATE: 5 April 1968

SUBJECT: SPS, DPS, APS and LM/RCS Propulsion Data Review

FROM: P. H. Janak
BLDG. H3 ROOM 2077 EXT. 2839

Reference: AVO from G. Holland, "Data Package/Task 6E Operations Data Books," dated March 26, 1968.

The following are the results of the requested (Reference) data review. The four systems (SPS, DPS, APS, and LM/RCS) are reported on in separate modules for ease of usage. To eliminate repetitive statements the following code was adhered to while reporting on each item:

A. If there is data readily available (as observed by this writer) to validate or satisfy a data requirement:

1 (Reference Y - XX Branch)

The reference is the source document. Since there is no guarantee that this is the latest and/or official data the cognizant MSC organization is also listed.

B. The data is not readily available (to this writer's knowledge) and should be requested from the cognizant MSC organization, who may not have it immediately available either:

2 (XX Branch)

C. The data is not readily available to the writer, but the probability is high that the cognizant MSC organization has it on hand:

2 (XX Branch), 3

Specific recommendations have also been made as to the manner of developing the requested data in many cases. This writer believes that the mission data books should contain nominal data (data of the mean engine) and engine-to-engine dispersions whenever possible. For most of the subject data requirements, such information can best be obtained from math models characterized to the nominal engine systems (as an example thrust versus inlet pressure). However some items, out of necessity, must be represented by typical (rather than nominal) test results. An example would be a valve postion/sensed pressure history curve. Ideally the typical test results will approach the statistical mean. In many cases there will not be enough tests of hardware at this time; thus the data of a unique system must be used.

Approved: John P. Aha

John P. Aha, Head
Performance Analysis Section

PHJ:bm
Enclosures

SYSTEMS 180 REV. 7-65

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YES ✓
NO

Enclosure A to TRW Letter
68.6520.3.3-82

TRW SYSTEMS

*70-25259

INTEROFFICE CORRESPON

TO: B. C. Hopkins

CC: Distribution

68.4711.8-110
DATE: 23 April 1968

CT: SPS Start and Decay Thrust

FROM: P. H. Janak
BLDG. H-3 ROOM 2077 EXT. 2839

rences:
1) Discussion with Dr. K. Cox, Head, Systems Analysis Section, Guidance and Control Division, concerning SPS Transients.
2) MSC Memorandum EG27-68-90, "Simulator Discrepancy Report," dated 2 April 1968.
3) IOC 68.4711.8-94, "Block II SPS Engine Transient Data," dated 29 March 1968.
4) Task 6E, CSM Data Book Draft.
5) Discussion with J. A. Wood, Assistant SPS Subsystem Manager, 22 April 1968.

A discussion with Dr. K. Cox (Reference 1) revealed the need for accurate SPS transient data for guidance and control analyses; both with regard to total impulse and general thrust time trend. The discussion brought to light an apparent discrepancy in nominal impulse values used by the ME 101 simulation (8981 lb-sec) and the command module computer (11,400 lb-sec). This discrepancy is discussed in Reference 2. Reference 3 presents a TRW analysis of SPS transients while Reference 4 presents the data presently incorporated by NR in the CSM/LM Spacecraft Operational Data Book Draft. All the above data is presented in Enclosure 1 for comparative ease. Although the data in Reference 4 was presented as a band, for convenience the average of the band was considered to be the mean and the band to be a 1σ dispersion about it. The enclosure shows that in view of the limited data available for analysis References 3 and 4 give excellent agreement (TRW and CSM Data Book). The 101 simulation agrees well on decay impulse also, while the CMC number is substantially larger. It seems apparent that this is because the later number is an estimate of total impulse out to the end of thrust decay, while the previously discussed numbers are to the 10% point.

After comparing the data both the writer and the SPS Subsystem Manager (Reference 5) agreed that the data of Reference 4 should be utilized by all concerned, since it is presented in the official data book and appears to be quite realistic. Also presented in Reference 4 is a typical buildup and decay

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SPS OVERSHOOT PHENOMENA STUDIES

1. 68.4711.8-194, "SPS Overshoot V·lve Time Correlation," dated 9 September 1968.
2. 68.4711.8-202, "SPS Overshoot Observed from Flight and Static Test Data," dated 18 September 1968.
3. 68.4711.8-206, "3σ Band for SPS Dual Bore Starts," dated 2 October 1968.
4. 68.4711.8-213, "3σ Band for SPS Single Bore Starts," dated 21 October 1968.

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TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

68.6374.5.1-003

TO: B. C. Hopkins CC: E. R. Ellison DATE: 11 April 1968

SUBJECT: Review of FCD Requested Data for Inclusion into the Operational Data Books*

FROM: D. M. Jolly

BLDG H-2 ROOM 2084 EXT. 2004

Reference: AVO "Data Package/Task 6E Operations Data Books" from G. Holland to Distribution, data March 26, 1968.

Per your request in the reference, the subject document has been reviewed and the following comments are submitted concerning ECS related data availability.

General

It is apparent from the following list of data requirements that there is an enormity of ECS data requested. It reflects an "all of everything philosophy". Much of the data is presently not available; it is not in the form requested nor is it validated. It is estimated that the effort required to compile this data would take more than 10 man years, not including the manpower requirements for additional testing. However, much of the data requested is specifically applicable to hardware design studies and would be of questionable value as regards operational information.

In order to achieve creditable results on this task, it is necessary to: 1) define the intended use of the data, 2) establish a consistent set of ground rules governing the use of the data, 3) generate a new list of requirements which is consistent with steps 1 and 2.

Data Requirements	Status/Comments
Section II - Data table, CSM thermal constraints for cold-plated equipment.	There is a sparse scattering of data on S/C electrical equipment for thermal loading; temperature operating limits, and temperature rise rates with loss of cooling. The MMDB, at present, contains data and cycling procedures on the inverter units but with respect to all other coldplated equipment there are no valid data sources. Tests have been performed for specific mission vehicles, but this data has not been documented. Valid data must be obtained by task assignment from ASPO.

* This review reflects TRW input only. Due to the large quantity of ECS data to be considered there has been insufficient time to coordinate the results with the cognizant MSC ECS authorities. However, coordination is being accomplished concurrent with this submittal.

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TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

68.6374.5.2-001

TO: M. Green CC: See Distribution DATE: 9 January 1968

SUBJECT: ECS Radiator Panel Isolation for AS 205 (ASPO Task 61)

FROM: P. Graf/C. Leavitt

BLDG H-3 ROOM 2046 EXT. 2848

Background

To determine the degree of ECS radiator coating degradation, a test objective has been written for the first manned Apollo mission that requires a CSM attitude hold with one radiator isolated and broadside to the earth. The radiator isolation requirement has produced questions about the isolated panel condition e.g., will the panel freeze? Could the panel be opened periodically to make sure it has not frozen? How long must the panel be open before there would be a positive response on spacecraft instrumentation?

Discussion

An analysis of the isolated panel was performed using the LTV transient radiator computer program. The following conditions were used for the analysis:

- 100 N.M. earth orbit with ECS radiator panel No. 1 isolated and broadside to the earth.
- The radiator coatings were assumed to be undegraded. This provides worst case condition for freezing.
- Panel one was isolated for four orbits after which the panel was opened to determine recovery time (an orbit begins at the subsolar point).
- Glycol heat load was approximately 6000 BTU/HR.

The earth facing isolated radiator panel will not freeze. Figure one shows the fluid temperature in the radiator tubes near the end of the fourth orbit (5.54 hours). This is the coldest period during the test.

Figure two is fluid temperature verses time of the smallest diameter selective stagnation tube taken near the outlet. This shows the response of the coldest portion of the radiator from the time the panel is shut off to more than one orbit past the time the panel was turned back on. At no time does the fluid temperature drop to freezing.

NARA SW Box E209H-112

TRW

68.3302.4-10
Re: Task E-66

26 March 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mrs. D. B. Lee, ES5

Subject: Submittal of Technical Memorandum, "Apollo Heat Shield Entry Heating Rates"

Gentlemen:

Enclosed is the subject TRW Systems technical memorandum which summarizes work accomplished in support of E&DD Task E-66.

A summary is presented for analytical development of the inverse solution for heat flow in the Apollo ablative heat shield. The approach was to utilize measured indepth temperature data and to derive the net heating rate at the ablator surface assuming negligible energy transfer interior to the heat shield from gases or reaction products. This analysis is expected to provide useful heating rate data in regions of relatively low heating, e.g., on the aft conical section of the vehicle.

A computer program has been developed for solving the inverse problem and is operational at Houston Operations. This program will be utilized in the correlation of measured Apollo entry heating rates. This solution technique could be extended for more general use to include ablation and ablation products, if desired.

Very truly yours,

TRW SYSTEMS

R. G. Payne, Manager
Task E-66

H. I. Leon, Manager
Apollo Engineering Analysis Project

RGP/jbm
Enclosure

NARA SW Box E209H-112

TRW No. 68-6500.1-108
Re: Task E-79

9 September 1968

National Aeronautics & Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. N. Kotanchik ES

Subject: Biweekly Status Report,
Saturn V POGO Analysis

Gentlemen:

Attached is the Biweekly Status Report, Saturn V POGO Analysis for the period ending 6 September 1968.

Stability analysis of the AS 503 vehicle has been updated during this period to include the latest available structural mode data and latest engine feed system dynamic characteristics.

Sincerely yours,

A. Rasumoff, Manager
Task E-79

H. I. Leon
Apollo Engineering Analysis Project

AR/nm

Attachments

cc: R. Albon (PP7)
R. V. Battey (PD)
J. A. Chamberlin (EA1)
Document Distribution (BF66)
W. R. Downs (ES)
R. P. Parten (FM13)

NARA SW Box E209H-112

TRW

TRW No. 68-6510.2.34

31 May 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. N. Kotanchik, ES

Subject: Weekly Status Report, Saturn V
POGO Analysis - Task E-79

Gentlemen:

Attached is the Weekly Status Report, Saturn V POGO Analysis, for the week ending 24 May 1968.

The major activity at this time continues to be a review of the MSFC Government Furnished Data (GFD) for the determination of the basic data necessary for the derivation of the analytical model.

Yours very truly,

H. I. LEON, Manager
Apollo Engineering Analysis Project

HIL:dan
Attachment

cc: Ralph Albon (PP7)
R. V. Battey (PD)
R. P. Parten (FM13)
Document Distribution (BF66)
W. R. Downs (ES)
J. A. Chamberlin (EA1)

NARA SW Box E209H-112

TRW

TRW No. 68-6510.2.39

10 June 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. N. Kotanchik, ES

Subject: Weekly Status Report, Saturn V
POGO Analysis - Task E-79

Gentlemen:

Attached is the Weekly Status Report, Saturn V POGO Analysis, for the week ending 31 May 1968.

The major activity at this time continues to be a review of the MSFC Government Furnished Data (GFD) for the determination of the basic data necessary for the derivation of the analytical model.

Yours very truly,

H. I. LEON, Manager
Apollo Engineering Analysis Project

HIL:dan
Attachment

cc: Ralph Albon (PP7)
R. V. Battey (PD)
R. P. Parten (FM13)
Document Distribution (BF66)
W. R. Downs (ES)
J. A. Chamberlin (EA1)

NARA SW Box E209H-112

TRW

TRW No. 68-6510.2.40

13 June 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. N. Kotanchik, ES

Subject: Weekly Status Report, Saturn V
POGO Analysis - Task E-79

Gentlemen:

Attached is the Weekly Status Report, Saturn V POGO Analysis, for the week ending 7 June 1968.

The major activity at this time is the finalizing of the analytical model with the latest propulsion system data, and the performance of stability analyses of the nominal Apollo Saturn Space Vehicle System during Stage I flight.

Yours very truly,

H. I. LEON, Manager
Apollo Engineering Analysis Project

HIL:dan
Attachment

cc: Ralph Albon (PP7)
R. V. Battey (PD)
J. A. Chamberlin (EA1)
Document Distribution (BF66)
W. R. Downs (ES)
R. P. Parten (FM13)

NARA SW Box E209H-112

TRW No. 68-6510.2.45

28 June 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. N. Kotanchik, ES

Subject: Weekly Status Report, Saturn V
POGO Analysis - Task E-79

Gentlemen:

Attached is the Weekly Status Report, Saturn V POGO Analysis, for the week ending 21 June 1968.

The significant results of last week's activity are (1) the parametric analyses to show the effect of changes in modeling of the oxidizer line bubble compliance, and (2) an analysis to show the effect on the stability gain margins of where the loop is opened, e.g., at the engine thrust or at the total force on the structure. Changes in the bubble model between that of Rocketdyne and MSFC were not too significant (within 2 db) except at t = 140 secs where a difference of 10 db was obtained. The effect on system gain of where the loop was opened was significant, as shown on Figure 1 of the status report.

Yours very truly,

for H. I. LEON, Manager
Apollo Engineering Analysis Project

HIL:dan
Attachment

cc: Ralph Albon (PP7)
R. V. Battey (PD)
J. A. Chamberlin (EA1)
Document Distribution (BF66)
W. R. Downs (ES)
R. P. Parten (FM13)

NARA SW Box E209H-112

TASK NO. E-79, "ANALYSIS OF APOLLO

SPACECRAFT/SATURN V POGO

WEEKLY STATUS REPORT, WEEK ENDING 14 JUNE 1968

During the subject week POGO stability analyses were performed of the basic Apollo Saturn Space Vehicle at the following times of Stage I flight:

t = 0, 20, 60, 90, 120 and 140 seconds

The calculated system gain at zero phase is shown plotted versus time of flight on Figure 1. Nominal values were used to represent the structure and propulsion system characteristics. Structural mode shapes and frequencies were calculated, where required, from the structural/dynamic model furnished by MSFC. Propulsion system data obtained from MSFC was supplemented by data provided by Rocketdyne, Canoga, as described in Attachment 1.

As may be seen from Figure 1, instability is shown in the region from t = 80 secs to t = 140 secs.

Based upon our analysis of the available data, and as discussed in Attachment 2, it appears that large variations may exist in some of the important propulsion system characteristics, such as the suction line compliance and the pump cavitation gain. Therefore, next week's activity will include a parametric study of the effect on system stability of variations in these and other propellant and propulsion system parameters. Finalization of the analytical model, Milestone No. 2, will also be accomplished during next week. In addition, TRW will continue modeling the two fixes presently being considered by MSFC; that is, (1) helium injection into the oxidizer suction line, and (2) the use of the oxidizer prevalve as an accumulator using helium gas in the prevalve cavity.

A. Rasumoff
TRW Task Manager

Attachment No. 1 - "Information Supplied to TRW for POGO Investigation," from B. F. Piper, Rocketdyne

Attachment No. 2 - TRW IOC 68.4711.5-105 "Test Deviations in F-1 Turbo-Pump Performance Parameters," to J. H. Walker

NARA SW Box E209H-112

TRW No. 68-6510.2.45

28 June 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. N. Kotanchik, ES

Subject: Weekly Status Report, Saturn V
POGO Analysis - Task E-79

Gentlemen:

Attached is the Weekly Status Report, Saturn V POGO Analysis, for the week ending 21 June 1968.

The significant results of last week's activity are (1) the parametric analyses to show the effect of changes in modeling of the oxidizer line bubble compliance, and (2) an analysis to show the effect on the stability gain margins of where the loop is opened, e.g., at the engine thrust or at the total force on the structure. Changes in the bubble model between that of Rocketdyne and MSFC were not too significant (within 2 db) except at $t = 140$ secs where a difference of 10 db was obtained. The effect on system gain of where the loop was opened was significant, as shown on Figure 1 of the status report.

Yours very truly,

for H. I. LEON, Manager
Apollo Engineering Analysis Project

HIL:dan
Attachment

cc: Ralph Albon (PP7)
R. V. Battey (PD)
J. A. Chamberlin (EA1)
Document Distribution (BF66)
W. R. Downs (ES)
R. P. Parten (FM13)

NARA SW Box E209H-112

68.6520.3.2-09
26 January 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: T.W. Holloway, CF34
Flight Crew Support Division

Subject: Task ASPO-49A, Transmittal of Informal Technical Report

Gentlemen:

The attached informal technical report is forwarded in fulfillment of Subtask 49A.2.14, EPS Consumables Interface Data.

Yours very truly,

G.L. Stout

G.L. Stout
Task Manager

V.R. Widerquist
Planning and Operations
Apollo Spacecraft Systems Analysis Program

GLS:GLS:VRW:jh

Distribution:

W.R. Kelly, PP7
R.V. Battey, PM3
J.P. Bryant, FM13
W.R. Morrison, PM3
Document Distribution, PA2

NARA SW Box E209H-112

68.6520.4.1-32
Re: Task E-64

19 April 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. C. Dallas, EE3
Instrumentation and Electronic Systems Division
Building 14, Room 109

Subject: Task E-64, Apollo Electromagnetic Compatibility Analysis

Gentlemen:

Attached are four (4) copies of the Apollo EMI/EMC Test Schedule Report. This material has been compiled to serve as a basis for system electromagnetic compatibility test planning. All known sources (MSC, MSFC, KSC, NR, and GAEC) have been interrogated, and the information obtained is thought to be accurate. Six important areas (e.g., EMU test schedules) have been identified as requiring additional (possibly new) data for program purposes.

This information will be used in our mission EMC report planning and EMC test recommendations. As additional information related to EMI/EMC and integrated system testing is received, this document will be revised.

TRW SYSTEMS HOUSTON OPERATIONS

E. L. Kells, Manager
Task E-64

Approved: _____
H. I. Leon, Manager
Apollo Engineering Analysis Project

HAS:ELK:go
Attachments (4)

cc: R. V. Battey/PD
J. A. Chamberlin/EA1
W. R. Kelly/PP7
R. P. Parten/FM (2)
L. Packham/EE
Document Distribution/BF66 (2)

NARA SW Box E209H-112

TRW

68.6520.4.1-90
Re: Task E-64A

27 September 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. C. Dallas, EE
Instrumentation and Electronic Systems Division
Building 14, Room 109

Subject: Transmittal of Data Definition Report-TRW Report 11176-H043-R000

Gentlemen:

Attached is TRW Systems' Data Definition Report. The collection and review of applicable data for the CSM and LM electromagnetic compatibility analysis has been a major effort within this task.

The data received and reviewed to date have been adequate to describe the CSM and LM interconnections and functions. In all areas, except the G&C subsystems, there has not been sufficient data available to firmly define signal characteristics and interface circuit impedances. The EMC analysis is impaired in its accuracy by the lack of such data. Engineering assumptions must be made where these data are not available. For Apollo systems, other than the CSM and LM (i.e., S-I and S-V, IU, ALSEP, and ACE), TRW has not been able to obtain any data except for CSM and LM ICD's, and requires information similar to that used in the analysis of the CSM and LM. Efforts are continuing to obtain data in the above areas.

TRW SYSTEMS

E. L. Kells, Manager
Task E-64A

*70-28306

Approved:
I. Leon, Manager
Apollo Engineering Analysis Project

HAS:ELK:pm
Attachment

cc: R. Albon/PP7
R. V. Battey/PD
J. A. Chamberlin/EA1
R. P. Parten/FM13 (2)
Document Distribution/BF66 (2)

ITT-FEC
VANGUARD BLDG.
RECORD COPY

YES ✓
NO

NARA SW Box E209H-112

TRW
SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE

68.4711.4-43

TO: Distribution CC: File DATE: 27 March 1968

SUBJECT: Selected Results from ORACLE-MAFIA Sensitivity Studies

FROM: C. S. Powers
BLDG 01 MAIL STA. 1180 EXT. 64042

REFERENCE: (1) TRW IOC 66.4711.5-56, "Magnitude of the Zero Gravity Can Manometer Effect," by Bernard Siegel, dated 7 December 1966.

(2) TRW TOR 05952-6116-T000, "Service Propulsion System Propellant Utilization and Gauging System Simulation," by Bernard Siegel, dated 27 January 1967.

(3) TRW IOC 68.4711.4-15, "ORACLE-MAFIA User's Manual: VII," by M. W. Alford, C. S. Powers, dated 30 January 1968.

In the course of the development of ORACLE-MAFIA, a number of runs were made to determine the characteristics both of the Apollo Service Propulsion System (SPS) model and of the MAFIA minimum variance algorithm. Since these runs produced information relevant to users of ORACLE-MAFIA, a selection of various cases will be documented in this memorandum. Two multiple case runs, Runs 11 and 21, will be discussed.

There is no significance to the run numbers, but because verbal discussions have been held about these two runs, this memorandum will retain the original designations. These two runs were actually made in Houston on the UNIVAC 1108. Without the assistance of Ezra Joseph, this study could not have been performed. These runs which consisted of multiple cases had to be run in groups of a few cases each and produced massive amounts of output. Ezra and Cliff Curtis endured the pain and frustration associated with trying to obtain such a high volume of production from heavily loaded computers and their help is gratefully acknowledged.

NARA SW Box E209H-112

TRW SYSTEMS GROUP

AZW

INTEROFFICE CORRESPONDENCE

TO W.L. Steele CC

68-7236.10-5
DATE 25 March 1968

SUBJECT Single Site Visibility Studies, Task E-71:
Preliminary Report on Site II-P-2

FROM R.A. Shea
K. Ziedman
BLDG S MAIL STA 2180 EXT. 66775

Summary

This report presents the results to date on selection of landmarks for Site II-P-2. Since the last report (on Site II-P-8) was issued, a Calcomp program to produce perspective plots has been completed and was used for the present study. The analysis for Site II-P-2 was performed for two launch dates, chosen to represent extremes of sun elevation angles and as large a range of approach azimuths as possible within the sun angle range constraint. The two conditions were: sun angle 13°, approach azimuth 86° and sun angle 6°, approach azimuth 102°. The results indicate that:

(1) For the 6° sun angle case, a set of about eight primary landmar. suffices to locate the landing point anywhere within the 99% ellipse.

(2) Many of the primary landmarks may not be visible for the 13° sun angle case because they fall in the washout area.

(3) Almost all of the important landmarks fall outside the 99% ellipse, consequently

- o little information is available to indicate a touchdown within the 50% ellipse

and

- o models for landmark recognition, if they are to be useful, must include areas outside the 99% ellipse.

R.A. Shea

K. Ziedman

SYSTEMS 180 REV. 3-67

NARA SW Box E209H-113

TRW
SYSTEMS GROUP

AZW

INTEROFFICE CORRESPONDENCE

68-7236.10-8

TO: W. L. Steele CC: DATE: 10 May 1968

SUBJECT: Single Site Visibility Studies, Task E-71; Preliminary Report on Site II-P-13

FROM: RA Shea and K Ziedman

BLDG	MAIL STA.	EXT.
R3	2004	66775

SUMMARY

This report presents preliminary results on visibility of landmarks for Site II-P-13. Sun elevation angles of 6° and 11.5° and a single approach azimuth of 88° were assumed. This site possesses a greater number and more distinctive landmarks than the two sites previously examined, II-P-8 and II-P-2, and the maximum sun angle has less affect on landmark visibility than for the other sites. In addition, a large crater, Maestlin G, is visibile through the right LM window which can provide general orientation information at the maximum sun elevation for a landing anywhere in the 99% ellipse. As for previous sites, however, the primary landmarks fall outside the 99% ellipse area and many downrange landmarks fall in the washout region for the high sun angle condition.

RA Shea

Richard A. Shea

K Ziedman

Kenneth Ziedman

NARA SW Box E209H-113

68:7250.5-4
Re: Task E-74

16 September 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. D. W. Gilbert

Subject: Discrepancy Report Status (5 September 1968)

Gentlemen:

Attached are the minutes of the 5 September 1968 Bi-weekly Discrepancy Report Meeting. Advance copies of the attachments have been submitted to your office.

A Status Summary report has been included to summarize the current status of 70 LM SUNDANCE discrepancies and 37 LM-AGS discrepancies. Those discrepancies that have been changed, closed and/or opened since the previous meeting have been noted in the Status Summary report.

This documentation was prepared under the Discrepancy Report Analysis and Documentation Task Item of Task E-74.

Very truly yours,

John T. Blake
Task Manager, Task E-74

Approved:

J. L. Coffman, Assistant Project Manager
Apollo Engineering Analysis Project

JTB:JLC:JEA:JG:js
Attachment:
Distribution: Ralph Albon (PP7)
R. V. Battey (PD)
R. P. Parten (FM13)
Document Distribution (BF66)
D. C. Cheatham
*J. A. Chamberlin (EA1)
R. G. Chilton

*Without Attachment

NARA SW Box E209H-113

68:7250.5-6
Re: Task E-74

19 September 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. D. W. Gilbert

Subject: Discrepancy Report Status (19 September 1968)

Gentlemen:

Attached are the minutes of the 19 September 1968 Bi-weekly Discrepancy Report Meeting.

These minutes include a summary of the current status of 27 LM SUNDANCE, 20 LM-AGS, 2 LM-LUM and 3 NR discrepancies that have been changed, closed and/or opened since the previous meeting have been noted in the Status Summary report.

This documentation was prepared under the Discrepancy Report Analysis and Documentation Task Item of Task E-74.

Very truly yours,

J E Alexander for

John T. Blake
Task Manager, Task E-74

Approved:

J. L. Coffman, Assistant Project Manager
Apollo Engineering Analysis Project

JTB:js
Attachment
Distribution: Mr. Ralph Albon (PP7)
Mr. R. V. Battey (PD)
Mr. R. P. Parten (FM13)
Document Distribution (BF66)
Mr. D. C. Cheatham (EG)
Mr. J. A. Chamberlin (EA1)
Mr. R. G. Chilton (EG)

NARA SW Box E209H-113

68:7250.5-9
Re: Task E-74

2 October 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. D. W. Gilbert (EG27)

Subject: Bi-Monthly Hybrid Simulator Discrepancy Status (October 1, 1968)

Gentlemen:

Attached are the updated NAR SUNDISK-101, GAEC SUNDANCE/AGS LM-3 and GAEC LUMINARY Discrepancy Report Status sheets as of 1 October 1968. Advance copies of the attachments have been submitted to your office.

A Status Summary has been included to summarize the current status of 29 CSM-101 SUNDISK, 69 LM3 SUNDANCE and 38 LM-3 AGS discrepancies.

This documentation was prepared under the Discrepancy Report and Analysis and Documentation Task Item of Task E-74.

Very truly yours,

John T. Blake
Task Manager, Task E-7

*70-28311

Approved:

J. L. Coffman, Assistant Project Manager
Apollo Engineering Analysis Project

JTB:js
Attachment
Distribution: *Mr. Ralph Albon (PP7)
*Mr. R. V. Battey (PD)
*Mr. R. P. Parten (FM13)
Document Distribution (BF66)
Mr. D. C. Cheatham (EG)
*Mr. J. A. Chamberlin (EA1)
*Mr. R. G. Chilton (EG)

*Without Attachment

ITT-FNC VANGUARD BLDG. RECORD COPY

NARA SW Box E209H-113

TASK E-59A

ANALYSIS OF SPACECRAFT/GROUND COMMUNICATION SYSTEM TEST REQUIREMENTS AND DATA EVALUATION

2TV-1 S-BAND EQUIPMENT TEMPERATURE MEASUREMENTS

for

SUBTASK E-59A-EB2-02

by

TRW SYSTEMS GROUP

H. D. Freeman, Manager
Task E-59A

D. Bartholomew, Manager
ISD Work Package

J. DeVillier, Manager
Communication and
Instrumentation Department

NARA SW Box E209H-113

TRW

68:7252.1-99
Re: Task E-74

1 July 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. D. W. Gilbert, EG27

Subject: Discrepancy Report Status (28 June 1968)

Gentlemen:

Attached are the updated status sheets incorporating the disposition of the 28 June 1968 Weekly Discrepancy Report Meeting. Advance copies of the attachments have been submitted to your office.

A Status Summary report has been included to summarize the current status of 45 LM-DAP and 7 LM-AGS discrepancies and 28 NR-101 discrepancies. Those discrepancies that have changed, closed and/or opened since the previous meeting have been noted in the Status Summary report. The appendix contains the background documentation of the new discrepancies received since the previous report.

This documentation was prepared under the Discrepancy Report Analysis and Documentation Task Item of Task E-74.

Very truly yours,

M. Fox
Task Manager, Task E-74

Approved:

J. L. Coffman, Assistant Project Manager
Apollo Engineering Analysis Project

MF:JLC:JEA:js
Attachment

Distribution: Ralph Albon (PP7)
R. V. Battey (PD)
R. P. Parten (FM13)
Document Distribution (BF66)
D. C. Cheatham (EG)
*J. A. Chamberlin (EA1)

*Without Attachment

TRW-FRC
VANGUARD BLDG.
RECORD COPY

YES ✓
NO

NARA SW Box E209H-113

TRW

68:7252.1-109
Re: Task E-74

23 July 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. D. W. Gilbert, EG27

Subject: Discrepancy Report Status (18 July 1968)

Gentlemen:

Attached are the updated status sheets incorporating the disposition of the 18 July 1968 Weekly Discrepancy Report Meeting. Advance copies of the attachments have been submitted to your office.

A Status Summary report has been included to summarize the current status of 63 LM-DAP discrepancies, 7 LM-AGS discrepancies, and 28 CSM-101 discrepancies. Those discrepancies that have changed, closed and/or opened since the previous meeting have been noted in the Status Summary report.

This documentation was prepared under the Discrepancy Report Analysis and Documentation Task Item of Task E-74.

Very truly yours,

M. Fox
Task Manager, Task E-74

Approved:

J. L. Coffman, Assistant Project Manager
Apollo Engineering Analysis Project

MF:JLC:JEA:js
Attachment
Distribution: Ralph Albon (PP7)
R. V. Battey (PD)
R. P. Parten (FM13)
Document Distribution (BF66)
D. C. Cheatham (EG)
*J. A. Chamberlin (EA1)
R. G. Chilton (EG)
*Without attachment

NARA SW Box E209H-113

TRW
SYSTEMS GROUP

AZW

INTEROFFICE CORRESPONDENCE

68-7236.10-004

TO: W.L. Steele

CC: E.L. Dean
L.G. Summers
C.V. Walker
A.Z. Weisz

DATE: 6 March 1968

SUBJECT: Lunar Visibility Study, Task E-72:
Preliminary Report on Site II-P-8

FROM: K. Ziedman
R.A. Shea
BLDG. S MAIL STA. 2180 EXT. 66775

SUMMARY

This report presents the results to date on the selection and identification of landmarks for Apollo site II-P-8. The techniques used in the analysis and the goals of this task are described also. The selection of landmarks is based on the following:

- Appearance and patterns of surface features as shown in vertical and oblique Orbiter photography.
- Feature patterns as shown in out-of-the window views (perspective plots).
- Visibility considerations.
- Availability of landmarks during descent and for different landing points.

Results for II-P-8 indicate that anticipated approach azimuths do not strongly affect choice of landmarks, either for their effect on patterning or on visibility of features. Sun elevation angle is a significant factor; the maximum elevation angle for II-P-8 is about 11° resulting in several otherwise useful features falling in the washout zone. A preliminary set of landmark features and patterns has been identified for this site. These patterns are useful for general orientation in the landing area and for locating the actual landing site with respect to the nominal.

Due to the unexpected large number of features that had to be examined, it was found necessary to develop a computer program to produce the perspective plots. This has delayed a complete analysis of II-P-8; however,

NARA SW Box E209H-113

TRW
SYSTEMS GROUP

MF

INTEROFFICE CORRESPONDENCE

68:7252.7-206

TO: T. H. Barrie

CC:

DATE: 12 March 1968

SUBJECT: Revision of "AS-501 Guidance, Navigation and Control System Flight Test Analysis Plan" Commensurate with the requirements of the AS-502 Mission

FROM: G. K. Thompson
BLDG H3 MAIL STA. 1022 EXT. 2721

References: TRW Letter 68:7252.7-101 and enclosure, TRW Interoffice Correspondence 68:7252.7-97 dated 22 February 1968 and 20 February 1968 respectively.

The AS-501 Test and Analysis document has been revised in the following manner in order to reflect the requirements of the AS-502 Mission.

Section 1. Introduction

1.1 Purpose

1.2 Scope

1.3 Summary and Critique

Delete references to AS-501 and substitute AS-502

Section 3. Mission Description

Title changed to Mission Summary and section rewritten per enclosure.

Section 4. Date Handling and Processing

4.1 Instrumentation Lists

4.2 Processing Requirements

4.3 Special Programs

Change paragraph 4.3.3 in accordance with the following:

$A0 = +0.4529848$ deg.
$A1 = +0.3468604$ deg/sec.
$A2 = +0.8983428 \times 10^{-2}$ deg/sec^2
$A3 = -0.2263229 \times 10^{-3}$ deg/sec^3
$A4 = +0.3907699 \times 10^{-5}$ deg/sec^4
$A5 = -0.331727 \times 10^{-7}$ deg/sec^5
$A6 = +0.1002752 \times 10^{-9}$ deg/sec^6

NARA SW Box E209H-114

TRW
SYSTEMS GROUP

THB MF

INTEROFFICE CORRESPONDENCE

68:7252.7-237

TO G. Holland

CC D. Rue
R. Boudreau

DATE: 4 April 1968

SUBJECT Preliminary Review of FCD Requested Data for Inclusion into the Operational Data Books.

FROM: A. J. Snygg
BLDG H3 MAIL STA. 1022 EXT. 2055

Reference: AVO dated 26 March 1968 from G. Holland, "Data Package/Task 6E Operations Data Books".

The data package originated by the FCD has been reviewed by T. Combs, R. D. Miller, and A. J. Snygg of the G&C Department and comments and recommendations are attached.

These comments are submitted as preliminary information only in order to meet the delivery deadline and to serve as a "talking paper" on which to base formal recommendations. Our comments are based on the assumption that the requested data is to be used during launch and/or flight operations. This assumption must be verified by FCD before our final recommendations are developed.

AJS:js
Attachments

NARA SW Box E209H-114

TRW SYSTEMS GROUP

THB

68:7252.7-256

INTEROFFICE CORRESPONDENCE

TO W. L. Steele CC DATE: 24 May 1968

SUBJECT Review of SUNDANCE GSOP/ Inflight Compensation and Calibration

FROM: T. A. Phythian
BLDG H3 MAIL STA. 1022 EXT. 2059

Reference: MIT Document "Guidance System Operations Plan for Manned LM Earth Orbital Missions Using Program SUNDANCE", R557, Section 2, 4, and 5.

The subjects of this review were inflight IMU compensation and calibration

1. Inflight Compensation

Inflight compensation involves a set of automated guidance computer functions established to eliminate the effect on IMU performance of certain estimated accelerometer and gyro errors. These functions compensate accelerometer output for estimated values of bias and scale factor errors. Additionally they provide compensating gyro torques to eliminate stable member drift induced by estimated values of gyro bias drift and certain acceleration-sensitive drift errors. The basic equations related to these functions are presented in Subsection 5.6.13 of the reference documents.

1.1 Correctness

The equations presented are correct as written.

1.2 Completeness

The presentation in Subsection 5.6.13 is somewhat skeletal. In order to complete this section for programming purposes, the following material should be added.

PIPA Compensation:

Activation - The periods of active PIPA compensation should be specified. In particular, the equations presented in GSOP Subsection 5.6.13 are intended for implementation at all times when the PIPA output registers (eraseable memory) are being sampled periodically. This occurs at half second interval during preflight gyrocompassing and at two second intervals during all period of "Average-g" navigation. During inflight periods in which "Average-g" navigation is not being performed, the PIPA output is accumulated continuously but is not processed. PIPA sampling and compensation inflight is resumed two seconds after the computer enters "Average-g" navigation mode.

*70-28332

ITT-FFC
VANGUARD BLDG.
RECORD COPY

YES ✓
NO

SYSTEMS 180 REV. 3-67

NARA SW Box E209H-114

ROUGH DRAFT

#68:7252.7-306
Re: Task E-71
19 July 1968

SOFTWARE REQUIREMENTS FOR THE

APOLLO COMMAND MODULE

IMU PRELAUNCH ERECTION AND GYROCOMPASSING PROGRAM

Prepared for

National Aeronautics and Space Administration

Manned Spacecraft Center

Houston, Texas

Prepared by T. A. Phythian

Approved by T. H. Barrie
Supervisor
Systems Test Analysis Section

Approved by W. L. Steele
Task Manager
Task E-71

Approved by W. J. Klenk
Assistant Manager for Software
Guidance & Control Department

*70-28333

ROUGH DRAFT

LTV-R&C
VANGUARD BLDG.
RECORD COPY

YES ✓
NO

NARA SW Box E209H-114

68:7252.7-355
Re: Task E-71A
30 September 1968

PRELIMINARY

VERIFICATION TEST PLAN

PROGRAM COLOSSUS

(SELECTED FUNCTIONS)

master

by

T. A. Phythian

System Test Analysis Section

TRW Systems Group

Houston, Texas

Prepared For:

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

*70-28334

ITT-FEC
VANGUARD BLDG.
RECORD COPY

NARA SW Box E209H-114

TRW SYSTEMS GROUP

DKP MF

INTEROFFICE CORRESPONDENCE 68:7252.8-71

TO W. Steele
Task Manager
Task E-71

cc Distribution

DATE 6 March 1968

SUBJECT Landing Radar Weighting Functions

FROM G. L. Stimmel

BLDG	MAIL STA.	EXT.
H-3	1023	2701

Reference: 05952-H381-R0-00, "Approach Terrain Evaluation: Sites II P-2, II P-6, II P-8, II P-11, and II P-13", C. McGee, 15 January 1968.

SUMMARY

The current concept of radar altimeter updating of the LM onboard estimated state vector during lunar descent will neglect any information available at estimated altitudes greater than 25,000 feet. Because of the possibility that radar information will become available at higher altitudes this study was undertaken to determine the effects of a similar update weighting function (decreasing linearly with increasing altitude - see Figure 1) which would update the state vector at estimated altitudes up to 35,000 feet.

This report explains the similarities and differences in pitch performance resulting from the two weighting functions for nominal and worst case conditions. The 35K weighting function generally gives better performance when radar is available at higher altitudes but worse if not unacceptable performance when radar data is not available at the higher altitudes. Delta V savings up to 34 feet per second were observed in cases where radar updating began at 35,000 feet on 1° slopes; Delta V losses never exceeded 3 feet per second.

Also shown are the effects of a similar weighting function whose zero value altitude would be set during flight to the value of estimated altitude at the time the pilot signals for updating to begin. This strategy was found to be unacceptable because with late radar acquisition the high gate miss errors were such that the post high gate E-guidance solution intersected the lunar surface before reaching the landing site. This strategy showed no performance improvement over the 35K weighting function with early radar acquisition.

*70-28335

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VANGUARD BLDG.
RECORD COPY

YES ✓
NO

NARA SW Box E209H-114

TRW SYSTEMS GROUP

DKP

INTEROFFICE CORRESPONDENCE 68:7252.8-78

TO: W L Steele
Task Manager
Task E-71

CC: Distribution

DATE: 8 March 1968

SUBJECT: Review of SUNDANCE GSOP (Section 5) in the Areas Covering P50's and R50's

FROM: W Ferry

BLDG H-3 MAIL STA 1023 EXT. 2727

Reference: MIT Document
"Guidance System Operations Plan for Manned LM Earth Orbital Missions using Program SUNDANCE"
R557, Section 5 - Guidance Equations November 1967

The comments listed in this memo resulted from a review of the Reference document in the areas covering the IMU Orientation Determination and IMU Alignment calculations. The specific areas reviewed were:

1. Section 5.6.3 - IMU Routines
2. Section 5.6.4 - Star Selection Routine
3. Section 5.5.4 - Lunar and Solar Ephemerides
4. Section 5.5.13 - LOSSEM Subroutine
5. Paragraph 5.6.2 - IMU Alignment Modes

The review was undertaken without reference to the SUNDANCE flight program, and therefore, does not include discrepancies between the two.

General Comments:

1. Although the Reference document gives an accurate and detailed explanation of the individual IMU subroutines, there is a lack of continuity between the various sections. A flow chart of the IMU Alignment computations similar to the Rendezvous Navigation Computation Logic Diagram (Figure 2.4-9) indicating subroutine sequencing and input/output variables would be valuable in relating the functions of the various routines.

2. The IMU Routines section fails to give the computations associated with the Auto Optics Positioning Routine (R-52). The section should indicate whether the gimbal angles required to point the optics LOS at the target celestial body are based on a three axis or single axis rotation of the LM.

*70-28356

LIT-PLC
SPRINGFIELD, VIRG.
REFERENCE COPY

MAIL ✓
NO

NARA SW Box E209H-114

TRW SYSTEMS GROUP

DKP

INTEROFFICE CORRESPONDENCE 68:7252.8-131

TO: W. Steele CC: Distribution DATE: 19 April 1968

SUBJECT: Program Requirements Document (PRD) for LM PGNCS P51(Task E-71)

FROM: T. Stimmel TS

BLDG.	MAIL STA.	EXT.
H-3	1003	2020

Attached is the requested draft of the PRD for the LM PGNCS IMU Orientation Determination Program.

TS:jr

Distribution

M. Fox
W. Klenk
D. Phillips
W. Ferry

NARA SW Box E209H-114

TRW SYSTEMS GROUP

THB JEA

INTEROFFICE CORRESPONDENCE 68:7254.3-391

TO File CC: DATE: 18 October 1968

SUBJECT Minutes of 17 October Simulator Discrepancy Meeting

FROM: L. L. Wilkerson

BLDG H4 MAIL STA. 1009 EXT. 3129

This report constitutes the minutes of the 17 October SDR Meeting and represents the status and recommended action for the NR and GAEC simulator discrepancies as of the date of the meeting. These minutes will also be used as the agenda for the forthcoming 31 October SDR Meeting. Appendix A contains the SDR status sheets for the new NR and GAEC discrepancies to be discussed at the forthcoming meeting. Appendix B contains a table listing categories of discrepancies and the quantity of each. The NR and GAEC Simulator Discrepancies were categorized and reported as follows:

I. CSM

A. SUNDISK

NR-101-29 - Closed 4 October 1968.

B. COLOSSUS

NR 103-1 - MIT report on COLOSSUS # 19 states that this discrepancy will be fixed after Revision 237 and incorporated into Program Note TBD for C'. FCSD will review for AOH impact.

NR 103-2 - COLOSSUS # 26 has been sent to MIT for analysis. NR analysis indicates that this discrepancy is a simulator problem. EG27 has taken the action to request NR to write a memo on the resolution of this discrepancy. This discrepancy will be closed upon receipt of the North American memo.

NR 103-3 - No change - COLOSSUS # 27 has been sent to MIT for analysis. Preliminary analysis shows that the "auto" mode is all right, but the discrepancy occurs if the crew does not fly the same way as the DAP.

NARA SW Box E209H-114

TRW
SYSTEMS GROUP

THB JEA

INTEROFFICE CORRESPONDENCE

68:7254.3-412

TO: File CC: DATE: 21 November 1968

SUBJECT: Minutes of the 21 November Simulator Discrepancy Meeting

FROM: L. L. Wilkerson
BLDG. H4 ROOM 1009 EXT. 3111

This report constitutes the minutes of the 21 November SDR meeting and represents the status and recommended action of the NR and GAEC simulator discrepancies as of the date of the meeting. These minutes will also be used as the agenda for the forthcoming 5 December SDR meeting.

Appendix A of this report contains the SDR status for the new NR and GAEC discrepancies to be discussed at the forthcoming meeting. Also included in this appendix are the final, signed off status sheets for those discrepancies closed in the 21 November meeting.

Appendix B contains summary tables listing discrepancies by quantity and catagory.

All outstanding 101 SDR's were re-examined and found adequately closed except NR-101-2, 7, and 26. Appropriate action has been, or is being, taken for any effects these discrepancies may have on 103.

The NR and GAEC simulator discrepancies are catagorized and reported as follows:

I. CSM

A. COLOSSUS

NR-103-1 - Closed in the 31 October minutes.

NR-103-2 - An addendum to this discrepancy was written 1 November 1968 by G. D. Sandberg defining this as a corrected simulator problem. Closed (A)

NR-103-3 - An AOH change is required to close this discrepancy.

NR-103-4 - An addendum to this discrepancy was written 1 November 1968 by G. D. Sandberg defining this as a corrected simulator problem. Closed (A)

NARA SW Box E209H-114

68:7254.4-16
Re: Task E-71A

27 September 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Dr. M. Kayton, EG21

Subject: Updated Terrain Evaluation of Sites II P-13 and III P-11 Resulting from Revised Terrain Profile and MSFN Data

References: 1) McGee, C., "Approach Terrain Evaluation: Sites II P-2, II P-6, II P-8, II P-11 and II P-13," TRW Technical Report No. 05952-H381-R0-00, dated 15 January 1968

2) McGee, C., "Terrain Evaluation of Site III P-11," TRW IOC 68:7252.6-76, dated 28 March 1968.

Gentlemen:

Enclosed is the subject TRW Systems Technical Memorandum No. 68:7254.4-5 dated 20 September 1968. Subsequent to the terrain evaluations of the five primary landing sites (References 1 and 2), there have been revisions in the estimates of an approach terrain profile to Site III P-11 and the initial condition errors at FTP due to MSFN tracking errors. The revised estimate of the approach terrain to Site III P-11 is considerably smoother than previously estimated. The smoother version of III P-11 significantly improves the performance of the LM during a descent to that site.

The updated estimate of MSFN errors results in an increase in the semi-major axis of the 3$ landing ellipse to 23,000 feet from the previous value of 13,000 feet. Inspection of all of the approach terrain to each of the five sites reveals that the increase in downrange error will not invalidate the earlier terrain evaluations of Sites II P-2, II P-6, and

NARA SW Box E209H-114

68:7254.3-431
Re: Task E-38B

12 December 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. John F. Hanaway (EG412)

Subject: G&C Data Requirements for Apollo Mission C Prime.

Gentlemen:

The attachment to this letter defines the data reduction requirements for the Apollo C Prime mission. It contains the following:

1) CMC Digital Downlink Description

2) CMC Downlink Tape Format

3) CMC Downlink Data Tabulation Formats

4) PCM Analog data Tabulation Formats

5) PCM Analog data Oscillograph Formats.

The information was formulated as an addendum to the "AS-205/101 Guidance, Navigation and Control System Flight Test Analysis Plan" prepared by TRW for the Apollo C Mission. It is submitted as partial fulfillment of TRW's Test and Analysis function as defined by Task E-38B, "G&C Test Analysis."

Yours very truly,

T. H. Barrie
Task Manager, Task E-38B

*70-28337

Approved:

W. R. Widerquist, Manager
Spacecraft Systems Analysis Project

THB:js
Attachment

ITT-FEC
VANGUARD BLDG.
RECORD COPY

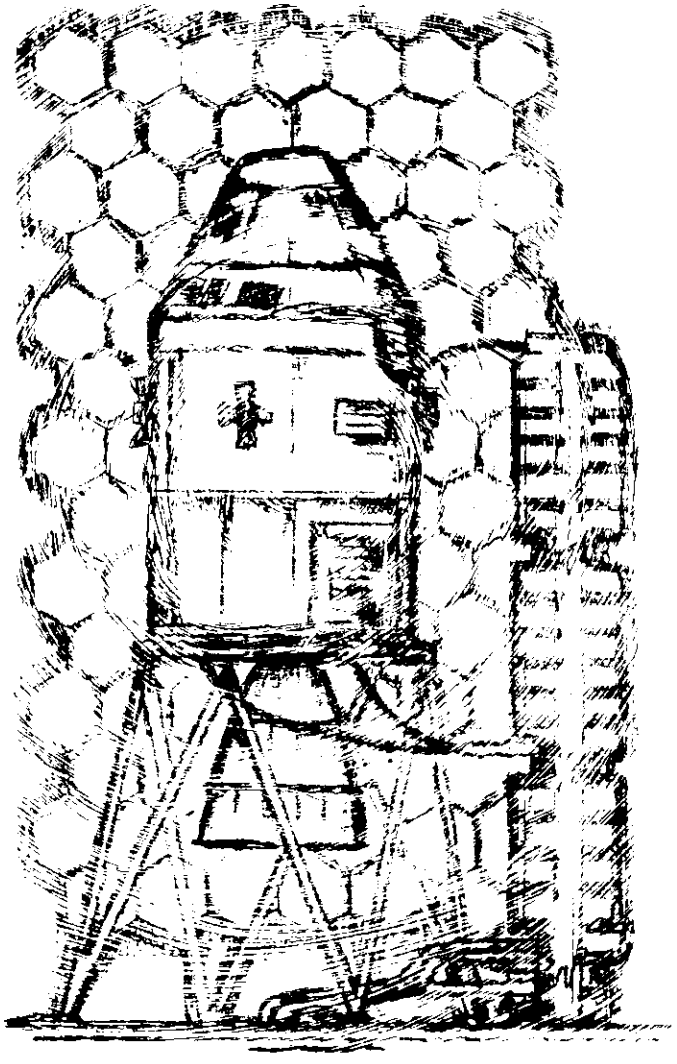
YES ___
NO ___

NARA SW Box E209H-114

BM 86

69.4352.10-12

TRW SYSTEMS
SERVICE MODULE (SM)
THERMAL MATH MODEL (TMM)
2TV-1/103 CORRELATION REPORT



Prepared for

NASA MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS GROUP

HEAT TRANSFER

HOUSTON OPERATIONS

NARA SW Box E209H-114

TRW

69.4354.1-130
5 September 1969
Re: Task E-63

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. C. A. Vaughan, Head
Reaction Control Section
Auxiliary Propulsion Branch
Propulsion and Power Division

Subject: First Draft of the CSM/RCS Integrated System Performance Analysis Computer Program User's Manual

Gentlemen:

The first draft of the CSM/RCS Integrated System Performance Analysis (ISPA) Computer Program User's Manual (Volume I) has been completed with exception for flow charts of the subroutines. The Table of Contents for this manual is attached to this letter. A copy of this draft has been provided to Mr. L. W. Jenkins to enable his comments to be included in the final document.

This document is the first of three volumes which will provide complete documentation of the ISPA computer program. Volume I contains documentation pertinent to the CSM/RCS program, a technical description and listings for the program, subroutines and all references. Volume II contains material appropriate to a user's guide including descriptions of the program input and output requirements and all details necessary to operate the program. Volume III will contain all information pertinent to the LM/RCS program. Portions of this program which are the same as for the CSM/RCS program will be referenced to Volumes I or II.

Sincerely,

Prepared by: P. J. Kovacs
P. J. Kovacs, Task Manager
Task E-63

Approved by: J. L. Coffman
J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

PJK:JLC:ad

Enclosure

NARA SW Box E209H-114

TRW No. 69-6500.1-16
Re: Task E-79

7 April 1969

National Aeronautics & Space Administration
Manned Spacecraft Center
Houston, Texas 70058

Attention: Mr. J. N. Kotanchik ES

Subject: Monthly Status Report, Period Ending 28 March 1969, Saturn V POGO Analysis, Stage II

Reference: MSFC Memorandum, S&E-ASTN-PA-69-M-127, 7 March 1969

Gentlemen:

We enclose copies of the J-2 Engine Transfer Function $\left(\frac{\partial T}{\partial P_{so}}\right)$ calculated and plotted from the data of the referenced memorandum.

We have performed an evaluation of the experimental and the data processing and analysis techniques that led to these transfer functions, and we are satisfied that the new functions are valid.

The new functions are significantly different from the TRW Engine Transfer Functions derived from basic principles. The differences are particularly marked in the late stages of flight when there is a low engine mixture ratio and a low NPSH. If flight conditions during the time an 18 cps POGO was observed on Flights AS-503, and AS-504 resulted in a mixture ratio of 4.7 and a head of 50 ft, then the TRW transfer function would be more than 10 db nonconservative in comparison to the new data. Early in flight, the TRW model is only 4 db nonconservative. Tentatively, we are attributing the differences largely to our imperfect understanding of the characteristics of the J-2 pump with high bypass flow. Studies are continuing.

The new engine transfer functions, together with the oxidizer line compliances which MSFC transmitted previously, appear capable of making a 16 cps (approximately) mode, (which is similar in both Boeing and NAR

NARA SW Box E209H-114

TRW

TRW No. 69-6500.1-25
Re: Task E-79

10 June 1969

National Aeronautics & Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. N. Kotanchik, ES

Subject: Monthly Status Report, Period Ending 31 May 1969,
Saturn V POGO Analysis

Gentlemen:

During the reporting period, TRW performed POGO stability analyses on the second stage of the Apollo Saturn Space Vehicle using updated structural and propulsion system data provided by MSFC. In addition, analyses were performed to predict the effect on the Apollo 10 mission (AS-505) of shutting down the second stage center engine early; i.e., prior to the time that POGO oscillations had been observed to occur on previous flights. These analyses predicted that this procedure would prevent the occurrence of POGO during second stage flight. This prediction has been verified by flight data from Apollo 10. The results of the S-II studies were forwarded to MSFC on 27 May in a report entitled "Apollo Saturn Space Vehicle POGO Analysis S-II Stage," TRW Document No. 11176-H192-R0-00 dated 27 May 1969.

Additional S-II stability studies have been initiated using new NA/SD S-II modal characteristics data. These data include the effects of a two mass representation of the S-II lox tank.

TRW's participation in the Saturn POGO analyses has been extended to 30 June 1969. During this time, the aforementioned S-II studies will be documented along with additional studies including the effects of a center engine accumulator.

Very truly yours,

A. Rasumoff
TRW Task Manager

J. L. Coffman, Asst. Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

AR:ds

NARA SW Box E209H-114

TRW

TRW No. 69.6510.2.102
Re: Task E-5C
9 January 1969

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. A. Chamberlin, EA4

Subject: December Progress Report - Task E-5C

Gentlemen:

During December, four special studies were continued from the previous month. A total of 3.8 manmonths was expended during December. The task activities are reported below:

1. SESL Chamber Thermal Environment

The objectives of this subtask are to evaluate the uniformity and validity of the solar simulator data that was gathered during the Spacecraft 2TV-1 CSM 103 support test, and to define the incident heating of the 103 test using the TRW SESL Chamber A Thermal Environment/2TV-1 Spacecraft computer program.

The final magnetic tapes containing the heating histories for test phases F and H were generated and placed in the MSC tape library.

During the next month, the final report documenting the CSM 103 test data analysis will be completed. This report will describe the heating rates that were transmitted and the problems encountered during the data analysis.

2. LM RCS Impingement Heat Transfer Analysis

One objective of this subtask is to determine the pressure and heat transfer distribution for constant and variable O/F mixture ratio plume at the exit plane and at several axial distances downstream and on the LM descent stage with and without the "coal chute." The second objective is to assist MSC in the design, set-up, and evaluation of an experimental program involving LM RCS plume measurements.

The final report for this task was submitted to MSC for review. Included in the report are: comparisons of measured heating rate and pressure data with theoretical predictions for the six probe locations that were used in the MSC TTA tests; heat transfer correlations at two locations for the Grumman scale model shock tube data:

NARA SW Box E209H-114

TRW No. 69.6510.2-107
12 February 1969

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. A. Chamberlin, EA4

Subject: January Progress Report - Task E-5C

Gentlemen:

During January, three special studies were continued from the previous month; one subtask was discontinued and replaced by a new study. A total of 4.2 manmonths was expended. The task activities are reported below:

1. SESL Chamber A Thermal Environment

The objectives of this subtask are to evaluate the uniformity and validity of the solar simulator data that was gathered during the Spacecraft 2TV-1 CSM103 support test, and to define the incident heating of the 103 test using the TRW SESL Chamber A Thermal Environment/2TV-1 Spacecraft computer program.

The final magnetic tapes containing the heating histories for test phases F and H were generated and placed in the MSC tape library. Using the above heat fluxes, analytical temperatures histories were generated by MSC to compare with the thermocouple readings obtained during the test. TRW has been investigating possible error sources associated with the above comparisons.

This subtask was completed during January with the generation of the F&H test phase tapes. No further work is planned except for resolution of data discrepancies that may be identified as the analytical temperature histories are reviewed.

2. LM RCS Plume Impingement Heat Transfer Analysis

The objective of this subtask is to determine the pressure and heat transfer distribution for a constant and variable mixture ratio plume at the exit, at several axial distances downstream, and on the LM descent stage with and without the "coal chute." A second objective is to assist MSC in the design, set-up, and evaluation of the Chamber A LM RCS test program instrumentation.

A nonequilibrium flow field was generated for the LM RCS nozzle. Various 2-zone combinations of mixture ratio were used with a wall boundary layer analysis to match the experimental performance of the engine. The final O/F ratio combination used was 0.5

NARA SW Box E209H-114

69.6510.2-110
Re: Task E-5

19 February 1969

National Aeromautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. J. A. Smith, ES 12

Subject: Apollo 9 Thermal Coatings Experiment Pre-Flight Measurement Report.

Gentlemen:

A report giving the pre-flight measurement results of Apollo 9 thermal coating samples is attached. This report presents the reduced data on the solar absorptance and emittance of thermal coating samples and the transmittance curves for window samples. Post-flight measurement of the samples will provide quantitative data regarding orbital degradation of coatings and windows. A post-flight report will be issued within 60 days after return of the samples. This report will provide a complete discussion of measurement and data reduction procedures.

TRW Systems

E. E. Luedke
Head, Thermophysics Section

Approved:

J. L. Coffman
Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

EEL:am

Enclosure

NARA SW Box E209H-114

68:7252.7-200
re: Task E-38A

March 1, 1968

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. John F. Hanaway

Subject: Postflight Analysis Support for the GN&C System LM-1

Gentlemen:

In its continuing role in support of the GN&C test analysis and reporting, TRW participated with MSC in the mission monitoring and postflight analysis and reporting functions for the LM-1 (AS-204) mission. To meet editorial deadlines for the several mission reports, analysis results prepared by TRW personnel were submitted informally as they became available. The purpose of this letter is to synopsize and confirm the data transmitted during that analysis effort, in partial fulfillment of the task requirement for submittal of a postflight report within forty days after launch.

In many cases, the preliminary data submitted were in the form of draft tabular data from which plots or graphs were prepared. Data of this form is not repeated here. It is recognized that large segments of the data analysis were performed as a team effort, and that the TRW contributions are in some cases inseparable.

In addition to the usual performance analysis, TRW personnel contributed to two anomaly investigations, the premature shutdown of DPS 1 and the Digital Autopilot (DAP) control system performance after the Program Reader Assembly burn sequence for DPS1, DPS3, FITH and APS 1. The support in these investigations was primarily in the area of LGC logic flow analysis and descriptions.

One item remains unresolved from the flight data analysis: unsymmetrical limit cycle during the DPS1 cold soak period. It is our understanding that action on this item has been assumed by Dr. K. Cox (EG23) and assigned to TRW for analysis under Task E-72, Apollo G&C Systems Evaluation.

NARA SW Box E209H-114

PRIME SITE TERRAIN EVALUATIONS

15 JULY 1969

69:7252.5-76

Prepared by
G. L. Stimmel
System Evaluation Section

TRW
SYSTEMS GROUP

NARA SW Box E209H-115

TRW SYSTEMS

INTEROFFICE CORRESPONDENCE

TO W. J. McKenzie

P. G. Bhuta/J. H. Walker
H. F. Korman
W. M. Moore
R. N. Schreiner
K. Ziedman

70-4340.4-8
DATE 30 March 1970

SUBJECT Descent Engine Plume Induced Surface Erosion During Apollo 11 and 12 Landings

FROM R. E. Hutton
BLDG R1 ROOM 1213 EXT 63610

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NARA SW Box E209H-115

B.7 8 6

TRW
SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE 70.6522.2-15

TO: File, Task E-74 CC: DATE: 23 March 1970

SUBJECT: Minutes of the ME-109 Simulator Discrepancy Meeting, NR, 18 March 1970

FROM: John E. Gifford
BLDG. H2 ROOM 2077 EXT. 2604

This report constitutes the minutes of the subject meeting conducted at the Manned Spacecraft Center. Included in this report are two appendixes. Appendix A contains new discrepancy reports and recently closed status sheets. Appendix B contains the disposition references.

The next SDR meeting will be scheduled at a later date. The current status of the NR ME-109 discrepancies is summarized below.

A. Software

NR-109-1 — During a Cislunar Navigation (P23) test run, it was discovered that the downlinked permanent CSM and LM state vectors were set to zero in position and velocity. Further investigation revealed that the anomaly occurred during the sphere of influence changeover (Moon to Earth-Centered System). The performance of the Cislunar Navigation was not visibly degraded by this occurrence. An MIT Anomaly Report, Comanche 35, has been issued for COLOSSUS 2E. A Program Note 1.3.2 has been issued for the Apollo 13 flight. Closed (A).

NR-109-3 — This discrepancy concerns the Auto Optics Acquisition and Fine Align during IMU Realign (P52). Following the first Fine Align in P52, the Auto Optics did not acquire the star in the SXT. Manual acquisition with the SCT was required. The NR investigation revealed that this discrepancy was caused by a programming error which has subsequently been corrected (Reference NR SCN 8024 Appendix B). Closed (A).

NR-109-4 — This discrepancy concerns Star Horizon Navigation Measurements during Cislunar Navigation (P23). Initially, it was observed that the state vector errors following each Cislunar Navigation update (star/horizon measurement) grow monotonically. It was also noted that the movement of the star in the SXT field-of-view was influenced by the nearness of the earth limb to the star. This resulted in making it very difficult to superimpose the star on the substellar point of the earth horizon. In an

NARA SW Box E209H-115

TRW
SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE

TO: File

CC: Distribution

70:7251-JP-1229
DATE: 6 March 1970

SUBJECT: February Informal Progress Report, Task E-9G

FROM: J. G. Prothro
BLDG. H-4 ROOM 2122 EXT. 3280

A. Apollo 13 RF Coverage Documents

Volume I (Operational Data) of the Apollo 13 coverage documents was submitted to MSC/TCSD for final review on 26 February. Preparation of Volume II (Lunar Operations) is presently in progress; however, aspect tapes are not expected until approximately 16 March. As a result of the late delivery of tapes, the scheduled delivery date (24 March) of Volume II can not be met. Volume II will be published as soon as possible, after receipt of tapes.

Calculations were completed for updating the LM S-band RF margin tables in the NASA Data Source handbook. The revised tables were delivered to MSC/TCSD in the form of camera ready reproduction mats on 24 February.

B. Study of Comb-Line Filtering of Video Signals

A summary of this months efforts on the comb-line filtering study is presented in Appendix A.

C. Lunar Far-Side Communications Study

The lunar far-side communications visibility and coverage analysis report was delivered to MSC on 6 February. This report contains an analysis of possible communications coverage that can be provided by low and medium altitude lunar orbiting satellites.

A summary of the tracking antenna technology literature survey containing charts depicting current interim results is presented in Appendix B.

All phases of this study are proceeding on schedule. The Phase II report is expected to be delivered on schedule (24 April).

NARA SW Box E209H-115

Attachment
70.7251.1-621

B.11 56

SPACECRAFT SYSTEMS ANALYSIS PROJECT

TASK E-34E

INFORMAL MONTHLY REPORT

4 March 1970

Approved by: Charles E. Blakely
C. E. Blakely, Task Manager

Approved by: John DeVillier, III
J. DeVillier, Manager
Communications and Sensor
Systems Department

NARA SW Box E209H-115

HKQ
GLA

TRW
SYSTEMS GROUP

INTEROFFICE CORRESPONDENCE

TO: Task E-74 File

CC:

70:7252.4-39

DATE: 7 April 1970

SUBJECT: ANALYSIS RESULTS OF APOLLO 13 SUPPLEMENTAL MISSION EVALUATION TEST CASE MAR 0906

FROM: J. W. Wright

BLDG. H4 ROOM 1013b EXT. 3197

References:
1) TRW IOC No.: 70:7254.5-23, "Revision of CSM Off-Nominal Hybrid Test Requirements," E. H. Peters, 20 February 1970
2) TRW IOC No.: 70:7252.5-08, "Off-Nominal H-2 Mission CSM Test Requirements - NR Hybrid Simulation," E. H. Peters, 30 January 1970
3) TRW IOC No.: 70:7252.5-40, "Analysis Results of Apollo 13 Final Mission Evaluation Test Case FEB 2501," J. B. Hill, 1 April 1970.

Introduction

This memorandum documents the results of North American Rockwell (NAR) hybrid simulation run number MAR 0906. This run is a simulation of the CSM/LM docked DOI maneuver with an SPS overburn of 1.6-seconds. The simulation was performed March 9, 1970, using the NAR hybrid test facilities at Downey, California.

The analysis performed by TRW was based upon data provided by NAR. The analysis consisted of a detailed review of the CMC downlink data and the Real-Time Simulator System (RTSS) digital environmental data. No RTSS analog strip-chart data or propellant utilization records were provided for the analysis of MAR 0906. Due to limited time and manpower, an in-depth analysis of the total volume of data was not possible. Hence, the analysis represents a compromise between detailed analysis and timely delivery.

The run represents an off-nominal condition and is intended to supplement the Apollo 13 final mission evaluation. The requirements defining this test case are presented in References 1 and 2. As defined in those references, the test case was to simulate a 2.8-second undetected SPS overburn during descent orbit injection. The intent was to evaluate the bailout procedures and maneuver under severe overburn conditions. Run MAR 0906, as actually performed, represents a 1.6-second detected SPS overburn during DOI requiring different procedures (essentially pitching the spacecraft over 180 degrees and nulling the VG's).

NARA SW Box E209H-115

TRW SYSTEMS GROUP

DKP

INTEROFFICE CORRESPONDENCE 68:7252.8-91

TO: W. L. Steele
Task Manager
Task E-71

CC: Distribution

DATE: 19 March 1968

SUBJECT: Review of SUNDANCE GSOP (Section 4) Covering IMU Programs P51 and P52

FROM: W. Ferry

BLDG	MAIL STA.	EXT.
H-3	1023	2727

Reference: MIT Document, "Guidance System Operations Plan for Manned LM Earth Orbital Missions using Program SUNDANCE", R-557, Section 4 - PGNCS Operational Modes, December 1967.

The comments listed in this memo resulted from a review of the Reference document in the areas covering the IMU Orientation Determination (P51) and the IMU Alignment (P52) operational modes. The specific programs and routines reviewed were:

1. P51 - IMU Orientation Determination
2. P52 - IMU Alignment
3. R02 - IMU Status Check
4. R50 - IMU Coarse Align
5. R51 - IMU Fine Align
6. R52 - Automatic Optics Positioning
7. R53 - Inflight Sighting Mark
8. R54 - Sighting Data Display
9. R55 - Gyro Torquing

The review was undertaken without reference to the SUNDANCE flight program, and therefore, does not include discrepancies between the two.

COMMENTS

1. Program P51 (Line #90)

At this point in the program, the crew is presented the option of maneuvering the LM to position the IMU inner gimbal axis in a preferred direction. This statement is misleading because the inner gimbal axis is attached to the stable member and therefore remains inertially oriented regardless of any spacecraft attitude maneuvers.

NARA SW Box E209H-115

APOLLO 12 DAP POSTFLIGHT ANALYSIS

20 JANUARY 1970 70:7254.4-7

TRW SYSTEMS GROUP

NARA SW Box E209H-115

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SYSTEMS GROUP

DEA WLS WPG

INTEROFFICE CORRESPONDENCE 70:7254.5-89

TO: Task E-72B File CC: Distribution DATE: 6/16/70

SUBJECT: DAP POSTFLIGHT ANALYSIS FOR APOLLO 13

FROM: W. Delashmit/R. Bennett
BLDG H 4 ROOM 2009 EXT. 3211

References: (1) NASA SNA-8-D-027, CSM/LM Spacecraft Operational Data Book, Volume III, Mass Properties, Revision 2, 20 August 1969.

(2) P. Pantason, Grumman IOC No. LAV-500-853, "Effects of RCS Jet Thruster Plume Deflectors on LM Attitude Control Authority," 17 March 1969.

(3) MIT/IL R-567, Guidance Systems Operations Plan For Manned LM Earth Orbital and Lunar Missions Using Program Luminary 1C, (Rev. 130), Section 3, Digital Autopilot, Revision 3, October 1969.

INTRODUCTION

An analysis of the DAP control functions during the Apollo 13 mission was performed to verify proper DAP performance. The following items were considered:

(1) The Midcourse Correction 4 (MCC-4) DPS Free Return Maneuver
(2) The Pericynthion plus two hours (PC+2) DPS Maneuver
(3) The maneuver to the LM PGNCS PTC attitude.
(4) The attitude hold capability of the LM DAP in the LM/CSM and LM/CM configurations.
(5) The automatic maneuver capability of the LM DAP in the LM/CSM configuration.
(6) The manual maneuver capability of the LM DAP in the LM/CSM and LM/CM configurations.
(7) The plus pitch torque acting on the CM after LM jettison.

MCC4 DPS FREE RETURN MANEUVER ANALYSIS

Jets 2, 6, 10, and 14 were used for a 4-jet, 8.01 second ullage prior to the MCC4-DPS Burn. The ullage began at 61:29:36.06 GET. DPS ignition

NARA SW Box E209H-115

ATTACHMENT TO
69:7254.4-73

DIGITAL AUTOPILOT SOFTWARE VERIFICATION TEST RESULTS FOR THE APOLLO 10 MISSION COMANCHE 45 AND LUMINARY 1

69:7254.4-73

NAS 9-8166

13 MAY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
W. R. Hamel
R. C. Kropf
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Control Systems Analysis Section

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NARA SW Box E209H-115

APOLLO SPACECRAFT DEVELOPMENT
MISSIONS AS-204A/205
STATUS BRIEFING

11 JULY 1966

NARA SW Box E209H-116

COPY NUMBER 062

APOLLO BLOCK II CSM
GUIDANCE AND CONTROL
DATA BOOK

REVISION 2

1 SEPTEMBER 1966

SUPERSEDES REVISION 1 DATED

7 SEPTEMBER 1965

Prepared by
TRW SYSTEMS
HOUSTON, TEXAS

NARA SW Box E209H-116

ER-7249

CONTINUED DEVELOPMENT OF A HYPERGOLIC ELECTRICAL POWER SYSTEM

FINAL REPORT

MARCH 1968

NASA MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

CONTRACT NAS-9-6879

TRW®
EQUIPMENT LABORATORIES

NARA SW Box E209H-116

11/16

17618-H050-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 NOVEMBER 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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17618-H084-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 JANUARY 1971

Prepared for
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17618-H118-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 MARCH 1971

Prepared for
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17618-H143-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 MAY 1971

Prepared for
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7/15 -H187

17618-H187-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 JULY 1971

Prepared for
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17618-H205-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

FOLLOW-ON CONTRACT TO NAS 9-8166

15 SEPTEMBER 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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17618-H015-R0-00

EP2/Freeburn reid cy of this task
EP5/Simon reid cy of this task

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 SEPTEMBER 1970

Prepared for
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17618-H023-R0-00

PROJECT TECHNICAL REPORT

CHARACTERIZATION OF THE ATTITUDE CONTROL PROPULSION SYSTEM

TASK PLAN

MSC/TRW TASK 705-1

NAS9-8166

September, 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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17618-H070-R0-00

PROJECT TECHNICAL REPORT

CHARACTERIZATION EVALUATION OF THE ATTITUDE CONTROL PROPULSION SYSTEM

INTERIM REPORT

MSC/TRW TASK 705-1

NAS 9-8166

December, 1970

Prepared for
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17618-H180-R0-00

PROJECT TECHNICAL REPORT

TRANSIENT ANALYSIS ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL

MSC/TRW TASK 705-1

NAS 9-8166

June, 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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17618-H179-RO-00

PROJECT TECHNICAL REPORT

CHARACTERIZATION OF ATTITUDE CONTROL PROPULSION SYSTEMS

MSC/TRW TASK 705-1

NAS 9-8166

June, 1971

Prepared for
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PROJECT TECHNICAL REPORT

STEADY-STATE ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL

VOLUME I

MSC/TRW TASK 705-1

NAS 9-8166

June, 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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17618-H204-RO-00

PROJECT TECHNICAL REPORT

STEADY-STATE ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL VOLUME II MSC/TRW TASK 705-1

NAS 9-8166

June, 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS GROUP

NARA SW Box E209H-118

70.4354.3-109
18 November 1970
Re: Task 705-2

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. W. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Analysis of Potential Oxygen Pressure Rise in the Cryogenic Storage System Lines Due to Thermal Effects

Reference: 1) North American Rockwell Letter 70MA6318, "Oxygen Tank Off-Load Procedures," E. P. Smith, 1 September 1970.

2) TRW IOC 70.4352.34-2, "Entrapped Oxygen Pressure Rise Analysis," J. P. Smith, 11 November 1970

Gentlemen:

Subsequent to high flow operation of the Cryogenic Storage System (CSS), it is possible to entrap low temperature gas in the system supply lines. An analysis to determine the approximate pressure rise due to the thermal response of the entrapped gas to the warmer environment has been completed for several conditions. Six conditions were enumerated in Reference 1. Reference 2 (enclosed) presents the results of the analysis for four of these conditions which were determined to be most significant. Briefly stated, these conditions were: (a) fuel cell shut-off valve closed in flight subsequent to a fuel cell oxygen purge; (b) fuel cell purge and shut-down subsequent to EVA high flow demand; (c) fuel cell purge and shut-down subsequent to LM pressurization flow demand; and (d) subsequent to EVA or LM pressurization, low temperature gas may be entrapped in the ECS supply line.

For condition (a), it was determined that the maximum pressure could be on the order of 1400 to 6000 psia depending on initial conditions and assumptions (cases B through D in Reference 2). For condition (b), the pressure could rise to approximately 4500

NARA SW Box E209H-118

10/26 HW

70.4354.3-96

RE: Task 705-2
21 October 1970

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. W. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Transmittal of Results of GNAT Test Case 3-One-Dimensional Potential Flow

Reference: TRW IOC 70.4354.3-93, "GNAT Test Case 3 - One-Dimensional Potential Flow," P. H. Heinmiller to File, Task 705-2, 10 October 1970.

Gentlemen:

The General Numerical Analysis of Transport (GNAT) computer program is being developed to simulate in detail the thermal stratification and mixing mechanisms in a compressible fluid subject to heating and accelerations as required under Subtask 2 (Advanced Cryogenic Tank Program) of Task 705-2.

In order to verify the accuracy of this computer program, a series of six test cases have been defined. Reference 1 (Attached) presents the results of Test Case 3, a simulation of a one-dimensional inviscid fluid expansion. The computed bulk pressures and temperatures are in very close agreement with corresponding values obtained from isentropic relations.

Sincerely,

R. K. M. Seto

R. K. M. Seto, Task Manager
MSC/TRW Task 705-2

J. L. Coffman

J. L. Coffman, Assistant Project Manager
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SYSTEMS GROUP OF TRW INC. **HOUSTON OPERATIONS** • P. O. BOX 58327, HOUSTON, TEXAS 77058 • (713) 591-3133

RKMS:JLC:nb
Attachments

NARA SW Box E209H-118

10/22

70.4354.3-95

RE: Task 705-2
20 October 1970

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: W. Simon, Task Monitor/EP5
MSC/TRW Task 705-2
Power Generations Branch
Propulsion and Power Division

Subject: Revision of Pressure Rise and Decay Rates for Spacecraft Operational Data Book (SODB)

Reference: TRW IOC 70.4352.36-1, "Revision of Cryogenic Pressure Base/ Decay Rates," in CSM/LM Spacecraft Operational Data Book, Volume 1," C. W. Wurst to R. K. M. Seto, 19 October 1970.

Gentlemen:

An analysis of the pressure rise and decay rates of the Cryogenic Gas Storage System based on the redesign of the system for H-Mission, has been performed. The results to be included in the CSM/LM SODB are presented in the reference (Enclosed). These results have also been implemented into the standard SODB approval loop. The transmittal of this information fulfills a milestone under Subtask 5 of Task 705-2.

Sincerely,

R. K. M. Seto

R. K. M. Seto, Task Manager
MSC/TRW Task 705-2

J. L. Coffman

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS/JLC/nb
Enclosures

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11/15

17618-H227-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

FOLLOW-ON CONTRACT TO NAS 9-8166 15 NOVEMBER 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-118

17618-H080-R0-00

PROJECT TECHNICAL REPORT

A NUMERICAL SOLUTION FOR THE PREDICTION OF PRESSURE COLLAPSE IN SUPERCRITICAL OXYGEN

MSC/TRW TASK 705-2

NAS 9-8166

DECEMBER 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NARA SW Box E209H-119

17618-H090-R0-00

PROJECT TECHNICAL REPORT

APOLLO CRYOGENIC SYSTEMS PROGRAMS

MSC/TRW TASK 705-2

NAS 9-8166

DECEMBER, 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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17618-H091-R0-00

PROJECT TECHNICAL REPORT

APOLLO CRYOGENIC SYSTEMS PROGRAMS

USER'S MANUAL
MSC/TRW TASK 705-2

NAS 9-8166

DECEMBER 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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17618-H101-RO-00

PROJECT TECHNICAL REPORT

APOLLO MISSION H3
CSM 110
CRYOGENIC STORAGE SYSTEM
PREFLIGHT PERFORMANCE REPORT

NAS 9-8166 FEBRUARY 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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TRW SYSTEMS GROUP

NARA SW Box E209H-119

17618-H121-RO-00

PROJECT TECHNICAL REPORT

USER'S MANUAL FOR THE GNAT COMPUTER PROGRAM
(NUMERICAL ANALYSIS OF STRATIFICATION IN SUPERCRITICAL OXYGEN)
MSC/TRW TASK 705-2

NAS 9-8166

March 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Approved by: J. M. Richardson for
O. W. Vernon, Manager
Power Systems Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-119

71.4354.3-28
13 May 1971
RE: Task 705-2 &
Task E-98

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. W. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Final Postflight Analysis Report for the Apollo 14 Mission Cryogenic Storage System.

Reference: 1) TRW IOC 71.4354.3-13, "Preliminary CSS Postflight Report for the Apollo 14 Mission, R. K. M. Seto to File, Task 705-2, 24 Feb. 1971.

2) TRW IOC 71.4354.3-27, "Final CSS Postflight Report for the Apollo 14 Mission, "R. K. M. Seto to File, Task 705-2, 24 Feb. 1971.

Gentlemen:

A preliminary evaluation of the Cryogenic Storage System performance during the Apollo 14 Mission was reported in Reference 1. Since that time additional postflight analysis of the system has been conducted. The results of this analysis are presented in Reference 2 (Enclosed).

This detailed analysis included effort in six areas:

a. Analysis of complete pressure cycling times for the oxygen tanks.
b. Analysis of the oxygen tank heater-on periods.
c. Determination of the maximum oxygen tank heater temperatures during each pressure cycle.
d. Performance of an energy balance study of the oxygen tanks for individual pressure cycles as well as several hour segments.
e. Determination of the rate of pressure change during oxygen tank heater-on periods.
f. Comparison of the measured quantities of remaining oxygen and hydrogen to that obtained using the measured temperatures and pressures.
g. Modification and improvements to the Integrated Systems Program based on flight data.

NARA SW Box E209H-119

17618-H186-R0-00

PROJECT TECHNICAL REPORT

APOLLO CRYOGENIC INTEGRATED SYSTEMS PROGRAM

USER'S MANUAL
MSC/TRW TASK 705-2

NAS 9-8166 JULY 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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PROJECT TECHNICAL REPORT

APOLLO MISSION J1
CSM 112
CRYOGENIC STORAGE SYSTEM
PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

JULY 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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17618-H058-R0-00

PROJECT TECHNICAL REPORT

APOLLO 12
CSM 108
SERVICE PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166

November 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Concurred by: Jack S. Kirkland
Z. D. Kirkland, Head
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Concurred by: James A. Wood
J. Wood, Manager
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Concurred by: Charles W. Yodzis
C. W. Yodzis, Chief
Primary Propulsion Branch

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R. J. Smith, Manager
Task E-19F

Approved by: P. H. Janak
P. H. Janak, Head
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17618-H153-RO-00

PROJECT TECHNICAL REPORT

APOLLO CRYOGENIC INTEGRATED SYSTEMS PROGRAM

MSC/TRW TASK 705-2

NAS 9-8166

MAY 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
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J. E. Cunningham

TRW SYSTEMS GROUP

NARA SW Box E209H-119

PROJECT APOLLO

ANALYSIS OF USE OF A BOILERPLATE FOR A SIMULATED CSM DURING CHAMBER "A" EMERGENCY REPRESSURIZATION

30 September 1965

2251-6006-RU-000

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

Contract No. NAS 9-4810
ASPO Task No. 17
Subtask No. 2
Work Item "C"

Prepared by
Mechanical Systems Department
TRW Systems

Prepared By: _____
S. Kreisler
Mechanical Systems Department

Approved: _____
A. Rasumoff
Work Package Manager
Task ASPO - 17

NARA SW Box E209H-11

PROJECT APOLLO

DETERMINATION OF SERVICE PROPULSION SYSTEM (SPS) SIMULATED PROPELLANT FLOW PROVISIONS

30 September 1965

2251-6007-RU-000

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

Contract No. NAS 9-4810
ASPO Task No. 17
Subtask No. 2
Work Item "B"

Prepared by
Mechanical Systems Department
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Prepared By: S. Kreisler
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Approved: A. Rasumoff
Work Package Manager
Task ASPO - 17

NARA SW Box E209H-11

Apollo Docking Test Device (ADTD)
Performance Analysis Document Evaluation

Task ASPO-17, Subtask 3

Prepared by: Fred W. Hermann

2251-6009-TU000

29 October 1965

Contract No. NAS 9-4810

Approved by: _____
Edward C. Wong

Approved by: _____
for Marvin Fox, Manager
Apollo G and C Project

Approved by: _____
Abner Rasumoff
Work Package Manager
Task ASPO-17

TRW Systems
One Space Park
Redondo Beach, California

NARA SW Box E209H-11

2251-6012-T0000

THERMAL RESPONSE PREDICTIONS FOR APOLLO COMMAND MODULE THERMAL PROTECTION SYSTEM

PART II. LAMINAR AND TURBULENT CONVECTIVE HEATING OF BODY POINTS IN PITCH PLANE

TECHNICAL OPERATING REPORT

1 December 1965

DISTRIBUTION AND REFERENCING

This report is not suitable for general distribution or referencing. It may be referenced only in other working correspondence and documents on Project Apollo by participating organizations.

TRW SYSTEMS

NARA SW Box E209H-11

2251-6013-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-1

PRELIMINARY ANALYSIS OF THE COMMAND MODULE-LUNAR EXCURSION MODULE INTERFACE LOAD DISTRIBUTION

CONTRACT NAS 9-4810

2 DECEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-11

2251-6015-T0000

PROGRAM TECHNICAL REPORT
TASK ASPO-17-(5)

A METHOD OF ANALYSIS FOR THE DETERMINATION OF THE RATIOS OF THE LOCAL REYNOLDS NUMBER TO THE FREE STREAM REYNOLDS NUMBER AT VARIOUS BODY POINT LOCATIONS ON THE APOLLO COMMAND MODULE

NAS 9-4810

15 DECEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-11

2251-6014-T0000

THERMAL RESPONSE PREDICTIONS FOR APOLLO COMMAND MODULE THERMAL PROTECTION SYSTEM

PART III. LAMINAR AND TURBULENT CONVECTIVE HEATING OF BODY POINTS NOT IN PITCH PLANE

15 December 1965

Prepared H. G. Myer

H. G. Myer

Approved A. A. Jensen

A. A. Jensen

Approved F. C. Loesch

F. C. Loesch

TRW SYSTEMS

NARA SW Box E209H-11

2251-6016-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-1

PRELIMINARY ANALYSIS OF THE SERVICE MODULE RADIAL BEAM FAILURE DURING ACOUSTIC TESTING

CONTRACT NAS 9-4810

28 DECEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-11

2251-6017-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-2

REVIEW OF
LTA-8 TEST PLAN
THERMAL-VACUUM-MSC

CONTRACT NAS9-4810

30 DECEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-11

2251-6018-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-2

PHYSICAL MEASUREMENT CONCEPTS FOR SPACECRAFT 008 THERMAL VACUUM TEST

CONTRACT NAS9-4810

21 JANUARY 1966

TRW SYSTEMS

NARA SW Box E209H-11

2251-6019-R0000

PROJECT APOLLO

TASK ASPO-17

FINAL STRUCTURAL ANALYSIS OF THE LAUNCH ESCAPE TOWER LEG ATTACHMENT

CONTRACT NO. NAS 9-4810

18 FEBRUARY 1966

TRW SYSTEMS

NARA SW Box E209H-11

2251-6020-R0000

PROGRAM TECHNICAL REPORT
TASK ASPO-17-(1)

COMMAND MODULE-SERVICE MODULE INTERFACE STRENGTH CAPABILITY, BLOCK I

CONTRACT NAS 9-4810

18 FEBRUARY 1966

TRW SYSTEMS

NARA SW Box E209H-11

2251-6021-T0000

PROGRAM TECHNICAL REPORT
TASK ASPO-17-(6)

INTERIM REPORT
STRUCTURAL DYNAMICS CHARACTERISTICS DOCUMENT

NAS 9-4810

1 MARCH 1966

TRW SYSTEMS

NARA SW Box E209H-11

2251-6022-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-13

REVIEW OF TEST PLAN FOR CHAMBER "A" SHAKEDOWN

NAS 9-4810

14 MARCH 1966

ITT-FEC
Vanguard Bldg.
Record Copy

Yes ✓
No

*70-28126

TRW SYSTEMS

NARA SW Box E209H-11

2251-6023-R0-000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-1

FINAL STRUCTURAL BREAK-UP ANALYSIS OF THE SERVICE MODULE AND SERVICE MODULE LEM ADAPTER FOLLOWING A LAUNCH ESCAPE SYSTEM ABORT

CONTRACT NAS 9-4810

17 March 1966

TRW SYSTEMS

NARA SW Box E209H-11

2251-6024-R0000

PROGRAM TECHNICAL REPORT
TASK ASPO-17-2

REVIEW OF VEHICLE PLAN FOR SPACECRAFT 008 - SECTION II GROUND OPERATIONS REQUIREMENTS PLAN

CONTRACT NAS 9-4810

18 MARCH 1966

TRW SYSTEMS

NARA SW Box E209H-11

Apollo Docking Test Device (ADTD)
Initial Condition Plan

27 September 1965

2251-6004-TU-000

Fred W. Hermann

Contract No. NAS 9-4810

Approved by: Edward C. Wong
Edward C. Wong

Approved by: Marvin Fox
Marvin Fox, Manager
Apollo G&C Project

Approved by: _____
Abner Rasumoff
Work Package Manager
Task ASPO-17

TRW Systems
One Space Park
Redondo Beach, California

NARA SW Box E209H-11

17618-H054-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION H3/LM-8/APS
PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

November 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
W. G. Griffin
Propulsion Technology Section
Power Systems Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

17618-H055-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION H3/CSM-110/SPS

PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

November 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
S. C. Wood
Propulsion Technology Section
Power Systems Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

17618-H061-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION H3/LM-8/DPS

PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

November 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
A. T. Avvenire
Propulsion Technology Section
Power Systems Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

12/30

70.4354.2-147
23 December 1970
RE: Task 705-3

Ltr DPS

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn
Propulsion and Power Division
Primary Propulsion Branch

Subject: DPS Supercritical Helium Pressurization System Preflight Analysis for Apollo Mission H-3

References: 1) TRW Letter 70.4354.2-125, "Task 705-3 Task Plan", R. J. Smith, dated 28 October 1970.

2) TRW Letter 70.4354.2-131, "Task 705-3 Schedule Revision", R. J. Smith, dated 5 November 1970.

3) TRW IOC 70.4354.2-146, "Incorporation of NBS Helium Equation of State Into TRW SHe Computer Program," R. S. Hoyle, dated 23 December 1970.

Gentlemen:

The Apollo Mission H-3 (LM-8) Descent Propulsion System (DPS) Supercritical Helium (SHe) Pressurization System preflight prediction required under MSC/TRW Task 705-3, Subtask 5, (References 1 and 2) has been completed. The analysis was accomplished with the aid of the TRW SHe computer program. As called for in the Task Plan (Reference 1), the program was modified (Reference 3) to incorporate the latest National Bureau of Standards equation of state for helium.

Predicted performance of the SHe system appears nominal with respect to previous Apollo preflight and postflight analyses. Table 1 shows the mission dependent input data for the SHe simulation; Figure 1 illustrates the DPS duty cycle; and Figure 2 presents the helium bottle pressure time history for the mission. Briefly the input data and computed performance are summarized as:

Initial He Load	48.5 lbm
Initial loaded pressure	120 psia
Time on pad	30 hrs.
Pre-launch pressure rise rate	8.15 psia/hr
Coast period rise rate	6.65 psia/hr
Helium bottle pressure at start of PDI Burn	1087.4 psia
Maximum helium bottle pressure for mission	1195.8 psia
Helium bottle pressure at touchdown	523.5 psia
Mass of helium remaining in bottle at touchdown	9.3 lbm
Helium pressure at oxidizer depletion	397.3 psia

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17618-H102-R0-00

PROJECT TECHNICAL REPORT

TASK 705-3

APOLLO J MISSION CLASS SERVICE PROPULSION SYSTEM

PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

January 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

17618-H103-R0-00

PROJECT TECHNICAL REPORT

TASK 705-3

APOLLO J MISSION CLASS DESCENT PROPULSION SYSTEM

PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

January 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

17618-H104-R0-00

PROJECT TECHNICAL REPORT

TASK 705-3

APOLLO J MISSION CLASS ASCENT PROPULSION SYSTEM

PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

January 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

3/17 Hic

71.4354.2-15
11 March 1971
RE: Task 705-3

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Apollo 14 Primary Propulsion Systems Preliminary Flight Evaluation

Gentlemen:

The attachment contains the preliminary postflight evaluations of the Ascent (APS), Descent (DPS), and Service (SPS) Propulsion Systems performance during the Apollo 14 Mission. The subject evaluations will be used as the Primary Propulsion Branch's input to the MSC Apollo 14 Mission Report, and were therefore prepared in a format and depth intended to ease their integration into that document. The results of the evaluation were delivered to your office in rough draft form on 2 March 1971. With your concurrence, the draft delivery data was extended approximately one week from the date called for in the Task Plan because of delays in the flight data processing at NASA/MSC. All significant changes from the rough draft have been previously discussed with the cognizant personnel in your office.

Sincerely,

R. J. Smith

R. J. Smith, Manager
MSC/TRW Task 705-3

J. L. Coffman

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RJS:JLC:skc

cc: R. H. Kohrs/PD7
H. D. White/EP
R. P. Parten/FM13
E. H. Yeater/EA5

bcc:

NARA SW Box E209H-120

17618-H129-R0-00

PROJECT TECHNICAL REPORT

APOLLO PRIMARY PROPULSION SYSTEM ENGINEERING MATHEMATICAL MODELS

NAS 9-8166

MARCH 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

17618-H137-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J1/CSM-112/SPS
PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

April 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
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NARA SW Box E209H-120

17618-H146-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J1/LM-10/APS
PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

May 1971

Prepared for
NATIONAL AERONATUICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

17618-H169-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J1/LM-10/DPS
PREFLIGHT PERFORMANCE REPORT

NAS 9-8166

May 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Applied Technology Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-120

71.4915.2-27
23 July 1971
RE: Task E-99/705-3

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Additional Apollo 15/Mission J1 DPS Preflight Performance Analyses

References: 1) TRW Letter 71.4354.2-46, Apollo 15/Mission J1 DPS Preflight Performance Prediction," R. J. Smith, 16 June 1971.

2) NASA SNA-9-D-027 (III) Rev. 3, "CSM/LM Spacecraft Operational Data Book, Vol. III, Mass Properties," 1 April 1971.

Gentlemen:

Subsequent to the issuance of Reference 1, several changes were made to the LM-10 mass properties and to the DPS propellant loading (Reference 2) which could affect the expected DPS performance values presented in Reference 1. These changes were:

1) An increase in the LM-10 mass at PDI from 36607.2 lbm to 36626.3 lbm.
2) A decrease in the DPS oxidizer load from 12042.1 lbm to 12023.7 lbm.
3) An increase in the DPS fuel load from 7541.1 lbm to 7547.7 lbm.
4) An increase in the expected non-DPS consumable usage during the descent burn from 87 lbm to 121.1 lbm.

The nominal descent burn simulations described in Reference 1 were re-run using the above changes. The resulting changes in the relevant performance results were:

1) The vehicle effective specific impulse, at touchdown, decreased from 302.4 seconds to 301.8 seconds.
2) The engine effective specific impulse, at touchdown, increased from 304.6 seconds to 304.8 seconds.
3) The expected low level sensor (Fuel #2) activation time increased from 731 seconds to 735 seconds after ignition.
4) The expected oxidizer depletion time increased from 850 seconds to 853 seconds after ignition.

NARA SW Box E209H-120

71.4354.2-20
23 March 1971
RE: Task 802

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

Attention: H. D. White/EP, Propulsion and Power Division

Subject: Gas Component Survey

References: 1) TRW Report 71.4354.2-18, "Survey of Gaseous Components Attitude Control Propulsion System (ACPS) Regulator, Accumulator, Relief Valve, and Quick Disconnect Coupling Survey," D. D. Tworek, 17 March 1971.

2) TRW Report 71.4350.2-1, "Attitude Control Propulsion System Feed Lines and Materials Survey," G. E. A. Thomann, 1 March 1971.

Gentlemen:

Attached are five (5) copies each of the referenced letter reports. These analyses were completed under the Attitude Control Propulsion System (ACPS) Gas Component Survey subtask of the Shuttle Vehicle Propulsion and Propellant System Analysis Task (Task 802).

The reports contain a summary of characteristics of "on-the-shelf" components that may meet the requirements of candidate Shuttle Vehicle ACPS's. These characteristics were received in reply to inquiries to a number of vendors considered among the leaders in component manufacturing. In addition, a guide to material selection for joints and feed lines is included. Copies of vendor catalogs and tables received will be made available to you and transmitted informally, if requested.

Yours very truly,

P. H. Janak, Manager
MSC/TRW Task 802

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

PHJ:jh

cc: J. Thibodaux/EP
N. Chaffee/EP4
C. Vaughn/EP4

bcc: J. M. Richardson
D. W. Vernon DWV
V. R. Widerquist
Technical Library/Houston

NARA SW Box E209H-120

SYSTEMS GROUP

INTERCOMPANY CORRESPONDENCE

TO: D. W. Vernon

CC:

DATE: 71.4354.3-21
30 March 1971

SUBJECT: Status of Shuttle Vehicle Analyses For The MSC Primary Propulsion Branch

FROM: P. E. Jones

BLDG	ROOM	EXT.
84	1103	3171

PU Study

Preliminary analyses have been completed and the results informally presented to PPB personnel. This analysis consisted of a determination of the 3 propellant outages for both the orbiter and booster MPS, and the payload cost resulting from the uncertainties associated with mixture ratio, Isp, and thrust. The outages were calculated for closed loop PU and no PU cases, each case with an optimum fuel bias and no fuel bias and a realistic range of possible mixture ratio uncertainties. The results of this study are attached and are identical to the results presented to the PPB except the payload cost for the orbiter fuel bias case has been decreased approximately 400 lbm to reflect an earlier accounting error. On the basis of these preliminary results, a PU system appears attractive for the orbiter and not so attractive for the booster. A fuel bias should be used in every case.

The preceding analysis was conducted by trading off propellant requirements with payload. At the request of the PPB we are determining the effects of a constant payload constraint (increasing propellant requirements to keep payload constant and maintain an FPR) on the conclusions of the preceding study. It was felt that such information may effect the system selection. The determination of these numbers have been made and they indicate that for every pound of propellant reserve carried, approximately 1.3 lbm of additional propellant are required to get it to orbit. We have had some difficulty in obtaining these solutions due to PATS numerical convergence problems. Therefore, the results should be used with caution while their validation continues.

Work has just begun to implement the procedure or two equations which approximate the angular correlation of thrust, Isp and O/F, into the PATS program. The logic has been developed and the equations should be checked out

NARA SW Box E209H-120

RETENTION OF ORBITAL INJECTION SYSTEM PROPELLANT RESIDUALS FOR USE BY THE ACPS

NAS 9-8166

6 APRIL 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Aeromechanics Laboratory
TRW Systems Group

NARA SW Box E209H-120

17618-H042-RO-00

PROJECT TECHNICAL REPORT

APOLLO PRIMARY PROPULSION SYSTEM PERFORMANCE ANALYSIS

TASK PLAN

MSC/TRW TASK 705-3

NAS9-8166

OCTOBER, 1970

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
R. J. Smith
Propulsion Technology Section
Power Systems Department

Approved by: _____
P. H. Janak, Head
Propulsion Technology Section

Approved by: _____
D. W. Vernon, Manager
Power Systems Department

TRW SYSTEMS GROUP

NARA SW Box E209H-120

5/4 Hou 21

71.4354.2-30
28 April 1971
RE: Task 802

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: H. D. White/EP
Propulsion and Power Divison

Subject: Orbital Maneuvering System Turbopump Thermal Analysis

References: 1) TRW IOC 71.4354.2-23, "Shuttle/OMS Turbopump Parameter Analysis," P. J. Knowles, 12 April 1971.

2) TRW IOC 71.4354.2-27, "Cryogenic Turbopump Model," P. J. Knowles, 22 April 1971.

Gentlemen:

The enclosed references summarize the turbopump thermal analysis model development presently taking place and present a plan for completion of that activity. Based on recent discussions with Primary Propulsion Branch personnel, emphasis will be placed on analyses of thermal transients after engine shutdown has occurred. Therefore, little additional attention will be given to the refinement of the steady-state model, although the references show that the simple steady-state model is presently operational.

Yours very truly,

P. H. Janak

P. H. Janak, Manager
MSC/TRW Task 802

J. L. Coffman

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

PHJ:skc

attachment

cc: J. Thibodaux/EP
C. Yodzis/EP2
R. Polifka/EP2
R. Kahl/EP2
M. Lausten/EP2

NARA SW Box E209H-121

17618-H147-R0-00

PROJECT TECHNICAL REPORT

SPACE SHUTTLE ORBITER MAIN PROPULSION SYSTEM

INTEGRATED TEST PHILOSOPHY

NAS 9-8166

May 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-121

5/26 Hcc

71.4354.2-39
21 May 1971
RE: Task 802

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: H. D. White, EP
Propulsion and Power Division

Subject: Engine Performance Analysis Computer Program Requirements

Reference: TRW IOC 71.4354.2-33, "Space Shuttle Engine Steady State Performance Analysis Computer Program Requirements Recommendations," D. D. Tworek, 4 May 1971.

Gentlemen:

The attached reference presents recommended requirements for the development of a Shuttle Vehicle engine performance analysis computer program. It was assumed that this program would be used for test data reduction and analysis and for performance simulation studies.

Sincerely,

P. H. Janak, Manager
MSC/TRW Task 802

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

PHJ:JLC:skc

Attachment

cc: C. Yodzis/EP2
Z. Kirkland/EP2
C. Gibson/EP2
J. Wood/EP2
R. Polifka/EP2
R. Kahl/EP2

NARA SW Box E209H-121

6/7 HSL

71.4354.2-40
28 May 1971
RE: Task 802

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: H. D. White, EP
Propulsion and Power Division

Subject: OMS Thermal Analysis

Reference: TRW IOC /1.4352.28-12, "OMS Turbopump Housing Temperature Response During Chilldown," G. M. Korb, 19 May 1971.

Gentlemen:

The attached reference presents a summary of the results of the OMS chilldown analysis that was terminated to allow the application of resources to a more pressing thermal analysis. The model developed is available to MSC personnel and represents a significant analysis capability.

Sincerely,

P. H. Janak, Manager
MSC/TRW Task 802

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

PHJ:JLC:skc

Attachment

cc: C. Yodzis/EP2
Z. Kirkland/EP2
C. Gibson/EP2
R. Kahl/EP2
R. Polifka/EP2
M. Lausten/EP2

NARA SW Box E209H-121

71.4354.2-45
21 June 1971
RE: Task 802

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: H. D. White, EP
Propulsion and Power Division

Subject: OMS Turbopump Thermal Analysis

Reference: TRW IOC 71.4352.28-13, "OMS Turbopump Thermal Modeling," G. M. Korb, 14 June 1971.

Gentlemen:

The attached reference documents two currently operational turbopump programs that can be used for simulating the thermal performance of OMS turbopumps. The method of program development and temperature levels throughout the turbopump assemblies obtained from program output are provided in the Reference. These programs are now available for MSC personnel use and provide significant tools for conducting OMS thermal analyses.

Sincerely,

DW Vernow, for
P. H. Janak, Manager
MSC/TRW Task 802

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

PJK:jh

Attachment

cc: C. Yodzis/EP2
Z. Kirkland/EP2
C. Gibson/EP2
R. Kahl/EP2
R. Polifka/EP2
M. Lausten/EP2

NARA SW Box E209H-121

17618-H147-R0-01

PROJECT TECHNICAL REPORT

SPACE SHUTTLE ORBITER MAIN PROPULSION SYSTEM

INTEGRATED TEST PHILOSOPHY (REVISION 1)

NAS 9-8166

June 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Technology Section
Power Systems Department
Aeromechanics Laboratory

TRW
SYSTEMS GROUP

NARA SW Box E209H-121

71.4915.2-55
2 November 1971
RE: Task E-98A

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: W. E. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Apollo 15 CSS Data Reduction Programs

Reference: TRW IOC 71.4915.2-54, "Apollo 15 CSS Data Processing Programs," R. K. M. Seto, 26 October 1971.

Gentlemen:

In performing the postflight analysis of the Cryogenic Storage System operation during the Apollo 15 Mission, six data processing programs were developed. The purpose of these programs is to aid in the more rapid analysis of the flight data. Two of the programs are data editing and copying routines. The other four programs are used in the analysis of the flight data including oxygen tank energy balance computations, pressure rise and decay rates calculations, heater on and off determination, and maximum tank heater temperature determination. The Reference (enclosed) further describes the use and provides a listing for each program. The program listings contain numerous comment statements describing the input requirements, program logic, and output available. The card decks* for these programs are also transmitted with this letter.

Very truly yours,

R. L. Morris, Subproject Manager
Chemical and Mechanical Systems
Spacecraft Systems Analysis Project

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS:jh

Enclosure

cc: R. Albon/BT12 **
W. A. Chandler/EP5
R. H. Kohrs/FD12
R. R. Rice/EP5
W. E. Rice/EP5
H. D. White/EP5 **W/O Enclosure

*Card decks transmitted to addressee only.

SYSTEMS GROUP OF TRW INC HOUSTON OPERATIONS • P. O. BOX 58327, HOUSTON, TEXAS 77058 • (713) 591-3133

NARA SW Box E209H-121

12/29

71.4910.42-13
21 December 1971
Re: Task E-98A

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: W. E. Simon/EP5

Subject: Apollo 15 Oxygen Tank Heater Temperature Analysis

Reference: TRW IOC 71.4910.42-12, "Comparison of Apollo 15 Oxygen Tank Heater Temperatures to Predicted Values," R. K. M. Seto to File, Task E-98A, 21 December 1971.

Gentlemen:

In order to verify the oxygen tank heater temperature data presented in the Apollo Fuel Cell and Cryogenic Storage Flight Support Handbook, a comparison of the Apollo 15 flight data and the corresponding handbook predicted values was performed (Reference). In general, it is concluded that the predicted values were in good agreement with the flight data, particularly when the vehicle was in the Passive Thermal Control mode and Lunar Orbit. While agreement was not as favorable when the vehicle was in the Attitude Hold mode, the predicted values of heater temperature were conservative. Thus, the handbook is useful for establishing the maximum temperatures that might occur in flight when in the Attitude Hold mode, although the actual values will probably be considerably below these predicted values.

Yours very truly,

R. L. Morris, Subproject Manager
Chemical and Mechanical Systems

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS:jh
attachment

cc: *R. Albon/BT12
W. A. Chandler/EP5
R. H. Kohrs/PD12
R. R. Rice/EP5
W. E. Rice/EP5
H. D. White/EP

*W/O attachment

NARA SW Box E209H-121

17618-H234-R0-00

PROJECT TECHNICAL REPORT

APOLLO 15 MISSION
CSM 112
CRYOGENIC STORAGE SYSTEM
POSTFLIGHT ANALYSIS REPORT
MSC/TRW TASK E-98A

NAS 9-12330

November 1971

Prepared for
National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

Prepared by
R. K. M. Seto
Propulsion Systems Section
Applied Mechanics Department

TRW SYSTEMS GROUP

NARA SW Box E209H-121

17618-H229-R0-00

PROJECT TECHNICAL REPORT

APOLLO CRYOGENIC INTEGRATED SYSTEMS PROGRAM

PROGRAMMER'S GUIDE

MSC/TRW TASK E-98A

FOLLOW-ON TO CONTRACT
NAS 9-8166

NOVEMBER 1971

PREPARED FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by:
R. K. M. Seto

TRW
SYSTEMS GROUP

NARA SW Box E209H-121

71.4915.2-43
4 November 1971
RE: Task E-98A

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: W. E. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Cryogenic Storage and Supply System
Pressurization Rates for the Apollo 15 Mission

Reference: 1) TRW IOC 71.4915.2-42, "Cryogenic Storage and Supply System Pressurization Rates for the Apollo 15 Mission," C. E. Barton to File, Task E-98, 4 November 1971.

2) TRW IOC 71.4915.2-54, "Apollo 15 CSS Data Processing Programs," R. K. M. Seto to File, Task E-98, 26 October 1971.

Gentlemen:

Transmitted herewith (Reference 1) is a set of pressurization plots† for the Apollo 15 Cryogenic Storage System (CSS). These plots show pressurization rates for the three oxygen tanks versus both tank quantity and ground elapsed time. The rates were computed from flight measured pressure data supplied by the Mission Support Division of MSC using a data processing program (Reference 2) developed under Subtask 1 (Apollo 15 Postflight Analysis). These rates may be used in the analysis of Apollo CSS flow, energy balance, and stratification phenomena.

Very truly yours,

R. L. Morris, Subproject Manager
Chemical and Mechanical Systems
Spacecraft Systems Analysis Project

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

CEB:ns
Attachment

†Pressurization rate plots transmitted to addressee only

NARA SW Box E209H-121

9/13

71.4915.2-40
1 September 1971
Re: Task E-98

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: W. E. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Apollo 15 Cryogenic Storage System Flight Data

Reference: TRW IOC 71.4915.2-39, "Apollo 15 CSS Flight Data," R. K. M. Seto to File, Task E-98 dated 1 September 1971

Gentlemen:

Transmitted herewith are a set of data plots* of thirty-five parameters related to the operation of the Apollo 15 Cryogenic Storage System (Reference). Also included is a list of data dropout periods and a set of mission event tables.

Very truly yours,

R. L. Morris, Subproject Manager
Chemical and Mechanical Systems
Spacecraft Systems Analysis Project

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS:jh

Attachment

cc: R. Albon/BT12
W. A. Chandler/EP5
R. H. Kohrs/PD
R. R. Rice/EP5
W. E. Rice/EP5
H. D. White/EP ✓

* Date Plots Transmitted to Addressee Only

NARA SW Box E209H-121

6/3

71.4354.3-35
28 May 1971
RE: Task E-98

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. W. E. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Oxygen Tank Heater Simulation Results

Reference: TRW IOC 71.4352.13-3, "Thermal Model of CSS O_2 Tank Heater," P. N. Hirasaki to File Task E-98, 25 May 1971

Gentlemen:

The Structures and Mechanics Division, MSC, provided a set of simulated temperature histories for the Apollo Cryogenic Storate System oxygen tank heaters. These histories were used to develop a simplified oxygen tank heater model that was incorporated into the Apollo Cryogenic Integrated Systems Program. Certain discrepancies including initial slope of curves, the magnitude of some of the curves and the temperature decay profiles at heater shutdown were noted. In order to correct the data and provide an independent check of the predicted temperatures, a thermal model of the heater column was developed using the Sinda program. The results of this model, the discrepancies observed in the data obtained from SMD, and limited comparisons with Apollo 14 flight data are discussed in the Reference (enclosed).

Due to the limited scope of this portion of the task, a comprehensive investigation of the simulation discrepances could not be accomplished. It is, however, recommended that further analysis of this area be performed.

Sincerely,

R. K. M. Seto

R. K. M. Seto, Task Manager
MSC/TRW Task 705-2

J. L. Coffman

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS:vs

NARA SW Box E209H-121

6/3

71.4354.3-34
28 May 1971
RE: Task E-98

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. W. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: Cryogenic Storage Tank Remaining Quantities Program.

Reference: TRW IOC 71.4354.3-32, "Program to Compute Remaining Quantities of Cryogens in the CSS Storage Tanks," R. K. M. Seto to File, Task E-98, 20 May, 1971.

Gentlemen:

A program has been developed to compute the remaining quantities of oxygen and hydrogen in the CSS storage tanks from the inflight measured tank pressures and temperatures. A discussion of the program and a program listing are presented in the reference (enclosed). A card deck also accompanies this letter.

The program may be used during a flight as a back up method for determining remaining quantities should the quantity measurement be lost.

Sincerely,

R. K. M. Seto

R. K. M. Seto, Task Manager
MSC/TRW Task 705-2

J. L. Coffman

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS:vs

Enclosure:

cc: R. H. Kohrs/PD7
J. G. Thibodaux/EP
W. A. Chandler/EP5
R. R. Rice/EP5
W. E. Rice/EP5
R. Albon/PP7

NARA SW Box E209H-121

5/25

71.4354.3-31
19 May 1971
RE: Task E-98

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. W. Simon, Task Monitor/EP5
Power Generation Branch
Propulsion and Power Division

Subject: CSS Oxygen Tank Heater Model

Reference: TRW IOC 71.4352.13-2, "CSS O_2 Tank Heater Temperatures for the Integrated Systems Program," P. N. Hirasaki to File, Task E-98, 18 May 1971.

Gentlemen:

A simplified oxygen tank heater model has been developed for use in the Apollo Cryogenic Integrated Systems Program. The model is based on heater simulation data supplied by the Structures and Mechanics Division (SMD) and Apollo 14 flight data. From these sources, a set of curve fits was developed defining the temperature measured by the heater column transducer as well as the hottest location on the heater column as functions of the number of heater elements active, the amount of oxygen in the tanks and the heater-on time. Based on these temperatures, an average heater column temperature was also defined for use with the simplified stratification model of the Integrated System Program in determining the heater energy transferred to the oxygen.

A description of the data and resulting curve fit equations are given in the reference (enclosed).

Sincerely,

R. K. M. Seto, Task Manager
MSC/TRW Task E-98

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS/vs

NARA SW Box E209H-121

20029-H149-R0-00

PROJECT TECHNICAL REPORT

SKYLAB SL2 MISSION

CSM 116

CRYOGENIC STORAGE SYSTEM

PREFLIGHT PERFORMANCE REPORT

MSC/TRW TASK E-98C

NAS 9-12330

DECEMBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
R.K.M. Seto
Propulsion Systems Section
Applied Mechanics Department

NARA SW Box E209H-121

20029-H138-R0-00

PROJECT TECHNICAL REPORT

APOLLO 17 MISSION
CSM 114
CRYOGENIC STORAGE SYSTEM
PREFLIGHT PERFORMANCE REPORT
MSC/TRW TASK E-93C

NAS 9-12330

NOVEMBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
R.K.M. Seto
Propulsion Systems Section
Applied Mechanics Department

NARA SW Box E209H-121

20029-H121-R0-01

PROJECT TECHNICAL REPORT

SIMPLIFIED CRYOGENIC STORAGE SYSTEM PROGRAM

MSC/TRW TASK E-98C

NAS9-12330

SEPTEMBER 1972
CHANGED NOVEMBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
R. K. M. Seto
C. E. Barton

TRW SYSTEMS GROUP

NARA SW Box E209H-121

4/23 - 71

71.4354.2-25
12 April 1971
RE: Task 802

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: H. D. White/EP, Propulsion and Power Division

Subject: Application of Composite Material Technology to Cryogenic Accumulators

Gentlemen:

Attached are five (5) copies of the subject report. This analysis was completed under the Attitude Control Propulsion System (ACPS) Gas Component Subtask of the Shuttle Vehicle Propulsion and Propellant System Analysis Task (802).

The attachment contains a summary of the present technology associated with cryogenic accumulators made of composite materials. The study shows that such containers offer considerable potential weight savings over more conventional containers, although these containers will likely be more expensive.

Yours very truly,

P. H. Janak, Manager
MSC/TRW Task 802

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

PHJ:jh

attachment

cc: J. Thibodaux/EP
N. Chaffee/EP4
C. Vaughn/EP4

NARA SW Box E209H-121

20029-H058-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J2
CSM 113
CRYOGENIC STORAGE SYSTEM
PREFLIGHT PERFORMANCE REPORT
MSC/TRW TASK E-98A

NAS 9-12330

March 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by:
R. K. M. Seto
Propulsion Systems Section
Applied Mechanics Department

NARA SW Box E209H-122

72.4910.42-16
10 January 1972
Re: Task E-98A

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: W. E. Simon/EP5

Subject: Revision of the Apollo Cryogenic Integrated Systems Hydrogen Tank Heat Leak Model

Reference: TRW IOC 72.4910.42-15, "Revision of the Hydrogen Tank Heat Leak Model for the Apollo Cryogenic Integrated Systems Program," R. K. M. Seto to File, Task E-98A, 10 January 1972

Gentlemen:

The Apollo 15 postflight analysis of the operation of the Cryogenic Storage System revealed the need to revise the hydrogen tank heat leak model. The model has been modified based on a new formulation recently made available by the Beech Aircraft Company. The reference (enclosed) documents the new model.

Yours very truly,

R. L. Morris, Subproject Manager
Chemical and Mechanical Systems

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RKMS:jh
attachment

cc: *R. Albon/ET12
W. A. Chandler/EP5
R. H. Kohrs/PD12
R. R. Rice/EP5
W. E. Rice/EP5
H. D. White/EP

*W/O Enclosure

NARA SW Box E209H-122

9/7 #0012

71.4915.2-35

30 August 1971
RE: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Apollo 15 Primary Propulsion Systems
Preliminary Flight Evaluation

Gentlemen:

The attachment to this letter contains the preliminary postflight evaluations of the Ascent (APS), Descent (DPS), and Service (SPS) Propulsion Systems performance during the Apollo 15 Mission. The subject evaluations will be used as the Primary Propulsions Branch's input to the MSC Apollo 15 Mission Report.

The results of the evaluations were delivered to your office in rough draft form on 20 August 1971 (SPS) and on 26 August 1971 (APS and DPS) in order to satisfy the Mission Report input schedule.

Very truly yours,

R. L. Morris

R. L. Morris, Subproject Manager
Chemical and Mechanical Systems
Spacecraft Systems Analysis Project

J. L. Coffman

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

RJS/jms

NARA SW Box E209H-122

17618-H214-R0-00

PROJECT TECHNICAL REPORT

APOLLO 14
CSM 110

SERVICE PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

Follow-on Contract to NAS 9-8166

September 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Systems Section
Chemical and Mechanical Systems Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-122

17618-H215-R0-00

PROJECT TECHNICAL REPORT

APOLLO 14
LM-8
ASCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

Follow-on Contract to NAS 9-8166

SEPTEMBER 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Systems Section
Chemical and Mechanical Systems Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-122

17618-H219-R0-00

PROJECT TECHNICAL REPORT

APOLLO 14

LM-8

DESCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

Follow-On Contract to NAS 9-8166

SEPTEMBER 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-122

PROJECT TECHNICAL REPORT

DESCENT PROPULSION SYSTEM
SUPERCRITICAL HELIUM PRESSURIZATION SYSTEM PROGRAM UPDATE

Follow-On Contract to NAS 9-8166

OCTOBER 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

By
P. J. Knowles

Approved by: R. J. Smith
R. J. Smith, Manager
MSC/TRW Task E-99

Approved by: J. M. Richardson
J. M. Richardson, Head
Propulsion Systems Section

Approved by: M. Beaumont for
D. W. Vernon, Manager
Chemical & Mechanical Systems Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-122

71.4915.2-56
2 November 1971
RE: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Ascent Propulsion System (APS) Characterization

Reference: TRW IOC 71.4915.2-47, "Ascent Propulsion System (APS) Characterization," 2 November 1971

Gentlemen:

Postflight analysis results through the Apollo 14 Mission indicated several possible discrepancies in the APS characterization used for preflight and postflight analysis. The reference presents the analyses of these discrepancies, the analyses of related characterization changes, and recommended model improvements.

Results from a number of past postflight analyses have indicated that the techniques used to predict APS specific impulse (Isp) may have been overly conservative. The reference contains a statistical analysis of the APS Isp biases determined by postflight analyses. The results of the analysis show that there is no statistically significant bias between preflight predicted and postflight derived values of Isp.

An APS chamber pressure measurement error model was derived in order to increase the utility of the APS chamber pressure measurement, GP2010, during postflight analysis. The final form of the model was a sixth degree polynomial with burn time as the independent parameter. The dependent variable from the polynomial is used as a time varying measurement bias. Data from the postflight analyses of LM-3, 4, 5, 6, and 8 were used in the derivation of the model.

Characterization of the APS throat erosion has been a recurring difficulty in most postflight analyses. The objective of the analysis discussed in the reference was to improve the throat erosion characterization presently in use; however, it was found that such a wide divergence in throat erosion characteristics existed that little improvement could be made. It is recommended that the presently used throat erosion characterization equations continue to be used for preflight prediction and that they be adjusted if required for postflight analyses.

NARA SW Box E209H-122

17618-H232-RO-00

PROJECT TECHNICAL REPORT

SPACE SHUTTLE VEHICLE
PROPELLANT UTILIZATION STUDY

NAS 9-12330

November 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
PROPULSION AND POWER DIVISION
HOUSTON, TEXAS

Prepared by
R. S. Hoyle
Propulsion Systems Section
Applied Mechanics Department

Approved by: R. J. Smith
R. J. Smith, Manager
MSC/TRW Task E-99

Approved by: J. M. Richardson
J. M. Richardson, Head
Propulsion Systems Section

Approved by: R. G. Payne
R. G. Payne, Manager
Applied Mechanics Dept.

TRW
SYSTEMS GROUP

NARA SW Box E209H-122

EP12 11/29/71

71.4910-42-5
18 November 1971
RE: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Pressure Fed Shuttle Booster Propellant Utilization Analyses

Reference: TRW IOC 71.4910-42-4, "Pressure Fed Shuttle Booster Propellant Utilization Analyses," 15 November 1971

Gentlemen:

The transmitted reference contains the results of the parametric analyses of the effects of booster propellant utilization on vehicle performance and on booster size for a LOX/propane pressure fed shuttle booster. The parametric data presented were generated at your request to support the current Propulsion and Power Division (PPD) analyses directed at establishing the requirements for an active propellant utilization (PU) system on the pressure fed booster.

The reference presents parametric data relating the effects of booster propellant outage on booster size, when the mixture ratio reserves are carried on the booster, and the effect of booster outage on weight-to-orbit when the reserves are included in the orbiter Flight Performance Reserves (FPR). Also included are data showing propellant outage and the optimum fuel bias for various mixture ratio uncertainties and nominal propellant loads and the effect on the maximum outage of selecting different probability levels. The reference recommends that further analyses be made to better estimate the propulsion system mixture ratio uncertainties expected for the pressure fed booster, and that alternate optimum fuel biasing criteria be examined.

Very truly yours,

R. L. Morris, Subproject Manager
Chemical and Mechanical Systems

J. L. Coffman, Assistant Project Manager
Engineering Analysis
Spacecraft Systems Analysis Project

cc: H. D. White/EP

SYSTEMS GROUP OF TRW INC **HOUSTON OPERATIONS** • P. O. BOX 58327, HOUSTON TEXAS 77058 • (713) 591-3133

NARA SW Box E209H-122

PROJECT TECHNICAL REPORT

APOLLO 16 MISSION J2/LM-11/APS PREFLIGHT PERFORMANCE REPORT

NAS 9-12330 November 1971

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared
by
W. C. Griffin
Propulsion Systems Section
Applied Mechanics Department

Approved by: R. J. Smith
R. J. Smith, Manager
Task E-99

Approved by: J. M. Richardson
J. M. Richardson, Head
Propulsion Systems Section

TRW SYSTEMS GROUP

NARA SW Box E209H-122

7/27 Hou 72

72.6531.42-76
21 July 1972
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Skylab Mission SL-2/CSM-116/SPS Preflight Performance Data

Reference: NASA/MSC Memorandum, "SPS Data Requirements for the Skylab Operational Data Book," from FM/Chief, Mission Planning and Analysis Division to EP/Chief, Propulsion and Power Division, dated 18 April 1972.

Gentlemen:

The attachment to this letter contains the preliminary Service Propulsion System (SPS) preflight performance prediction data for Skylab Mission SL-2 requested in the Reference. The attachment was prepared in a format suitable for convenient incorporation into the Skylab Operational Data Book (ODB) and was delivered to you for review on 10 July 1972.

Following your approval, a copy of the attachment was delivered to MSC/TRW Task KM-207 personnel to expedite incorporation of the data in the ODB.

Very truly yours,

R. G. Payne, Subproject Manager
Chemical and Mechanical Support

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RJS/ns

NARA SW Box E209H-122

6/26

TRW

72.4910.42-66
16 June 1972
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2

Subject: Computer Simulation of LM RCS Test Data

References:
1) Thompson, P. F., "Reaction Control System (RCS) Fluid Transients; LM RCS Computer Simulation Comparison to Test Data," TRW IOC 72.4910.42-59, 1 June 1972.

2) Thompson, P. F. and Walsh, T. J., "Characterization of Attitude Control Propulsion Systems," MSC/TRW Task E-99, NAS 9-12330, TRW Systems Group, Houston, Texas, February 1972.

3) "Transient Analysis Attitude Control Propulsion Systems Computer Program Documentation and User's Manual," TRW Technical Report 20029-H045-R0-00, February 1972.

4) Blevins, D. R., "Apollo Lunar Module Reaction Control Subsystem Test," Internal Note No. MSC EP-R-68-17, 1 October 1968.

Gentlemen:

Transmitted herewith are five copies of Reference 1, which presents the results of a simulation of actual LM RCS test data (Reference 4) using TRAP (Transient Analysis Attitude Control Propulsion Systems Computer Program, References 2 and 3). The analysis was performed to verify the operation of TRAP and provide confidence in the program for future applications. The analysis consisted of a simulation of the LM RCS System B configuration. The combustor simulated was located in Quad II (combustor U9) and was operated through a 50 millisecond duty-cycle. The propellant feedline pressures were monitored during the test and the simulated values compared to the test data. The computer simulation of the LM RCS System B test data gave very accurate results. The simulation gave identical frequencies for the oxidizer and fuel inlet pressures and gave pressure amplitude accuracies within 5 percent for the fuel pressure and 6 percent for the oxidizer pressure. The combustor simulation provided reasonable results except that the combustor pressure

NARA SW Box E209H-122

6/7

TRW

72.4910.42-60
31 May 1972
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2

Subject: Comparison of LM Descent Engine S/N 1044 and S/N 1027

Reference: TRW IOC. 72.4910.42-52, "Comparison of DPS Engines S/N 1044 and S/N 1027", A. T. Avvenire, dated 1 May 1972.

Gentlemen:

The referenced memorandum transmitted herewith documents a recent analysis which was performed at your request in order to support MSC's decision to replace the LM-12 Descent Engine S/N 1044 with engine S/N 1027. The analysis provided the necessary propulsion system performance data (both nominal and dispersion data) on each engine for MPAD to assess the comparative propellant margins for an Apollo 17 (LM-12) mission with either engine. The data were generated by performing nominal and Monte-Carlo dispersion simulations, for each engine, of the Apollo 17 Descent Burn using the Descent-Ascent Monte-Carlo Program (DAMP). The most significant result of the analysis was that the overall effective specific impulse with engine S/N 1027 was found to be 0.81 seconds greater than with engine S/N 1044. Because all the information required to generate a final detailed prediction for the Apollo 17 Descent Burn was not available, the absolute performance values presented should be considered preliminary. However, the differences between the two engines are considered valid and provided sufficient information to compare the two engines. The results of this analysis were delivered to you in draft form on 11 May 1972 and this letter serves to document the previously delivered information.

Very truly yours,

R. G. Payne, Subproject Manager
Chemical and Mechanical Systems

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RKMS:ns

NARA SW Box E209H-122

5/25

TRW

72.4910.42-54
10 May 1972
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Reaction Control Propulsion System Fluid Transients - Central Versus Modular Propellant Tank Configuration.

Reference: TRW IOC No. 72.4910.42-53, Reaction Control System Fluid Transients; Central Tank Versus Modular Tank Configuration," 5 May 1972.

Gentlemen:

Transmitted herewith are five (5) copies each of the referenced memorandum which contains the results of a study to compare the fluid transients between central and modularized propellant tank configurations for a Reaction Control System (RCS). Detailed plots of the systems flowrates and pressures are presented in the report. Where appropriate, fluid damping requirements are also identified.

In general, the long propellant lines associated with the central tank configuration will experience large hydraulic transients. The analysis indicated that maximum pressures due to valve closure may reach 684 psia and resulting rarefaction waves could lower the system pressure to the vapor pressure of the propellant. Under these conditions, any requirements for thrust could not be met. Therefore, accumulators are required in the central tank configuration to dampen the fluid transients. The results of the study indicate no significant hydraulic transients will exist in the modularized tank configuration.

NARA SW Box E209H-122

6/20

TRW

72.4910.42-62
14 June 1972
Re: Task E-98A

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: W. E. Simon, Task Monitor, EP5

Subject: Documentation Revision for the Apollo Cryogenic Integrated Systems Program

References:
1. TRW Technical Report No. 17618-H153-R0-00, "Apollo Cryogenic Integrated Systems Program," R. K. M. Seto, C. E. Barton, J. E. Cunningham, May 1971.
2. TRW Technical Report No. 17618-H186-R0-00, "Apollo Cryogenic Integrated Systems Program, User's Manual," R. K. M. Seto, July 1971.
3. TRW Technical Report No. 17618-H229-R0-00, "Apollo Cryogenic Integrated Systems Program, Programmer's Guide," R. K. M. Seto, November 1971.
4. TRW IOC 72.4910.42-39, "Revised Dynamic Heater Model for Apollo Cryogenic Systems Program," C. E. Barton, 27 March 1972.
5. TRW IOC 72.4910.42-15, "Revision of the Hydrogen Tank Heat Leak Model for the Apollo Cryogenic Integrated Systems Program," R. K. M. Seto, 10 January 1972.

Gentlemen:

Since the time that the Apollo Cryogenic Integrated Systems Program (HC005A) was originally documented (References 1-3) numerous revisions, additions and modifications have been implemented in the program. The principal revision was the reformulation of the oxygen tank heater temperature model (Reference 4) while the principal addition was the inclusion of a detailed hydrogen tank heat leak model (Reference 5). The program changes have been documented and it is requested that the revised pages (enclosed) be inserted into the original documents. A list of the effective page changes follows the new signature page for each document.

NARA SW Box E209H-122

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 MARCH 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 MAY 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

20029-H099-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 JULY 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

9/18 HOS

20029-H116-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 SEPTEMBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

11/15 White

20029-H134-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 NOVEMBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

20029-H154-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 JANUARY 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-123

20029-H167-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 MARCH 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

20029-H180-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 MAY 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

TRW
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NARA SW Box E209H-123

20029-H200-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 JULY 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

20029-H209-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 September 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

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20029-H224-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 November 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

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20029-H230-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 January 1974

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

20029-H041-RO-00

PROJECT TECHNICAL REPORT

STEADY-STATE ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL VOLUME II MSC/TRW TASK E-99

NAS 9-12330

January 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS GROUP

NARA SW Box E209H-123

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-12330

15 JANUARY 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-123

20029-H042-RO-00

PROJECT TECHNICAL REPORT

CHARACTERIZATION OF ATTITUDE CONTROL PROPULSION SYSTEMS

MSC/TRW TASK E-99

NAS 9-12330

February, 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-124

20029-H045-R0-00

PROJECT TECHNICAL REPORT

TRANSIENT ANALYSIS ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL

MSC/TRW TASK E-99

NAS 9-12330

February, 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS GROUP

NARA SW Box E209H-124

4/14

72.4910.42-45
10 April 1972
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn
Propulsion and Power Division
Primary Propulsion Branch

Subject: Amendment to the Apollo Mission J2/LM-11/DPS Preflight Performance Report

Reference: TRW Project Technical Report 20029-H054-R0-00, "Apollo Mission J2/LM-11/DPS Preflight Performance Report," A. T. Avvenire, C. R. Savino, March 1972.

Gentlemen:

A revision to the reference preflight analysis has been necessitated by several recent changes in the amount of propellants defined as unusable in the Descent Propulsion System (DPS) tanks and the amount of propellants considered to be below the low level sensors in the oxidizer and fuel tanks. Most significantly, these changes decreased the amounts of propellant defined as unusable by 14.2 lbm for oxidizer and 6.1 lbm for fuel. As a result of the revisions noted above, the predicted low level sensor actuation time (fuel tanks) has been reduced by approximately three seconds and the predicted hover time remaining at the end of the nominal predicted Descent Burn has been increased from 138 seconds to 141 seconds. The total predicted burn time to depletion has been increased by three seconds.

Required changes to the reference report are contained on the attached pages ten (10) copies of which are transmitted herewith. Changes are indicated by a vertical bar in the page margin. The amended pages should replace the originals.

Personnel associated with MSC/TRW Task ASPO-6K have been informed of these revisions to expedite incorporation in the Spacecraft Operational Data Book.

Yours very truly,

R. G. Payne, Subproject Manager
Chemical and Mechanical Systems

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

NARA SW Box E209H-124

20029-H047-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J2/CSM-113/SPS
PREFLIGHT PERFORMANCE REPORT

NAS9-12330

FEBRUARY 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Systems Section
Applied Mechanics Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-124

20029-H054-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J2/LM-11/DPS
PREFLIGHT PERFORMANCE REPORT

NAS 9-12330

MARCH 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
A. T. Avvenire
Propulsion Systems Section
Applied Mechanics Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-124

20029-H062-R0-00

PROJECT TECHNICAL REPORT

APOLLO 15

LM-10
ASCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

MARCH 1972

NAS 9-12330

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Systems Section
Applied Mechanics Department

NARA SW Box E209H-124

4/18

72.4910.42-46
13 April 1972
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Apollo Mission J2/CSM-113/SPS Preflight Performance Report Change

Reference: TRW Letter 72.4910.41-26, "Apollo Mission J2/CSM-113/SPS Preflight Performance Report," 16 February 1972.

Gentlemen:

The mission planning for Apollo 16 has been revised with respect to the Lunar Orbit Plane Change 1 (LOPC 1) burn. The mission planning now calls for the LOPC 1 burn to be performed, exclusively, in the Single Bore (B Bank) mode of operation by the Service Propulsion System (SPS). The enclosed tables present the effective engine performance and dispersions for each of the SPS burns to be performed according to the latest mission planning. These tables should replace Tables 10 and 11 in the above referenced document.

Yours very truly,

R. G. Payne, Subproject Manager
Chemical and Mechanical Systems

V. R. Widerquist, Manager
Space Systems Analysis Project

RJS:ns

MSC
cc; *R. Albon/BT12
*M. H. Sands/BB22
R. H. Kohrs/PD12
H. D. White/EP12
Technical Library Branch/JM6
*Technology Utilization Office/JM7

NARA SW Box E209H-124

20029-H079-R0-00

PROJECT TECHNICAL REPORT

SPACE SHUTTLE PROGRAM, ORBITAL MANEUVERING SYSTEM (OMS), INTEGRATED SYSTEM TEST PROGRAM

NAS 9-12330

APRIL 1972

PREPARED FOR
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by:

Propulsion Systems Section
Applied Mechanics Department

NARA SW Box E209H-124

20029-H084-R0-00

PROJECT TECHNICAL REPORT

APOLLO 15

LM-10

DESCENT PROPULSION SYSTEM FINAL FLIGHT EVALUATION

NAS9-12330

APRIL 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-124

20029-H102-R0-00

PROJECT TECHNICAL REPORT

APOLLO 15
CSM 112
SERVICE PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-12330

JUNE 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Systems Section
Applied Mechanics Department

NARA SW Box E209H-124

20029-H109-R0-00

PROJECT TECHNICAL REPORT

IMPROVEMENTS TO THE TRANSIENT ANALYSIS ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM

MSC/TRW TASK E-99

NAS 9-12330

AUGUST 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-124

20029-H123-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J3/CSM-114/SPS
PREFLIGHT PERFORMANCE REPORT

NAS9-12330

OCTOBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Propulsion Systems Section
Applied Mechanics Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-124

20029-H126-R0-00

PROJECT TECHNICAL REPORT

APOLLO 17 MISSION J3/LM-12/APS
PREFLIGHT PERFORMANCE REPORT

NAS9-12330 OCTOBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared
by
W. G. Griffin
Propulsion Systems Section
Applied Mechanics Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-124

20029-H040-RO-00

PROJECT TECHNICAL REPORT

STEADY-STATE ATTITUDE CONTROL PROPULSION SYSTEMS COMPUTER PROGRAM DOCUMENTATION AND USER'S MANUAL VOLUME I MSC/TRW TASK E-99

NAS 9-12330

FEBRUARY 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS GROUP

NARA SW Box E209H-124

TRW

72.6531.42-109
29 December 1972
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Skylab Missions SL-3 and SL-4/CSM-117 and CSM-118/SPS Preflight Performance Data

Reference: NASA/MSC Memorandum, "SPS Data Requirements for the Skylab Operational Data Book," from FM/Chief, Mission Planning and Analysis Division to EP/Chief, Propulsion and Power Division, dated 18 April 1972.

Gentlemen:

The attachment to this letter contains the Service Propulsion System (SPS) preflight performance prediction data for Skylab Missions SL-3 and SL-4 requested in the Reference. The attachment was prepared in a format suitable for convenient incorporation into the Skylab Operational Data Book (ODB).

Very truly yours,

R. J. Smith, Task Manager
Task E-99

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RJS:jo

NARA SW Box E209H-125

6531.11-73-07
16 January 1973
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2

Subject: Apollo 17 Primary Propulsion Systems Preliminary Flight Evaluation

Gentlemen:

The attachment to this letter contains the preliminary postflight evaluation of the Ascent (APS), Descent (DPS), and Service (SPS) Propulsion Systems performance during the Apollo 17 Mission. The subject evaluations will be used as the Primary Propulsion Branch's input to the MSC Apollo 17 Mission Report.

The results of the evaluations were delivered to your office in rough draft form on 12 January 1973 (APS and DPS) and on 16 January 1973 (SPS) in order to satisfy the Mission Report input schedule.

Very truly yours,

R.K.M. Seto, Task Manager
Task E-99

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RKMS:jo

cc: R. H. Kohrs/PD12
J. D. Norris/EP2
*M. H. Sands/BB22
H. D. White/EP12
Technical Library Branch/JM6
*Technology Utilization Office/JM7

NARA SW Box E209H-125

6531.11-73-09
19 January 1973
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2

Subject: Apollo Propulsion Data Reduction and Plotting

Reference: TRW IOC 72.6531.42-107, "Data Reduction Requirements for Apollo 17," C. R. Savino, 22 December 1972.

Gentlemen:

Because the performance of the SPS, DPS, and APS propulsion systems appears to have been satisfactory during the Apollo 17 Mission, there have been no requirements to process the flight data. If the need arises, however, the procedure necessary to process and plot the flight data are presented in the attached document.

Very truly yours,

R.K.M. Seto

R.K.M. Seto, Manager
Task E-99

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RKMS:jo

*Appendices to addressee only.

cc: R. H. Kohrs/PD12
H. D. White/EP12

NARA SW Box E209H-125

2/3 White

6531.11-73-14
7 February 1973
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2

Subject: Ascent Propulsion System Specific Impulse Study

Gentlemen:

Subsequent to the flight of LM-8 (Apollo 14), a statistical study was conducted to determine if the method used to predict the specific impulse of the Ascent Propulsion System (APS) was too conservative. The reason for initiating the study was because postflight evaluation of the APS performance indicated that the inflight engine specific impulse was greater than predicted for several vehicles.

With each additional Apollo flight, the study has been reviewed and updated. The enclosure presents the results of the latest update and includes the data from LM-11 (Apollo 16).

It was found that the computed flight performance increase was not statistically significant and, therefore, no changes to the APS performance prediction methods are warranted.

Yours very truly,

R.K.M. Seto

R.K.M. Seto, Manager
Task E-99

M. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RKMS:jo

RKP

cc: R. H. Kohrs/PD12
H. D. White/EP

NARA SW Box E209H-125

2/28 Zo Letter

6531.11-73-15
16 February 1973
Re: Task E-99

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas 77058

Attention: F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Skylab Mission SL-4/CSM 119 Back Up SPS Preflight Performance Data

Reference: NASA/MSC Memorandum, "SPS Data Requirements for the Skylab Operational Data Book," from FM/Chief, Mission Planning and Analysis Division to EP/Chief, Propulsion and Power Division, dated 18 April 1972.

Gentlemen:

The attachment to this letter contains the back up Service Propulsion System (SPS) preflight performance prediction data for Skylab Mission SL-4 requested in the Reference. The attachment was prepared in a format suitable for convenient incorporation into the Skylab Operational Data Book (ODB).

Very truly yours,

R.K.M. Seto

R.K.M. Seto, Manager
Task E-99

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RSMS:jo

JMR for RKP

cc: A. A. Bishop/KM2
R. H. Kohrs/PD
H. D. White/EP12

NARA SW Box E209H-125

6/20 Withdrawn

C531.11-73-51
15 June 1973
Re: Task E-99

National Aeronautics and Space Administration
Johnson Space Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2
Propulsion and Power Division
Primary Propulsion Branch

Subject: Apollo-Soyuz Test Program Mission ASTP/CSM 111 SPS Preflight Performance Data

Reference: NASA/JSC Form, "Request for ASTP Operational Data," from WC3/Operational Data Branch to EP/Propulsion and Power Division dated 17 April 1973.

Gentlemen:

The attachment to this letter contains the Service Propulsion System (SPS) preflight performance prediction data for Apollo-Soyuz Test Program Mission requested in the Reference. The attachment was prepared in a format suitable for convenient incorporation into the ASTP Operational Data Book (CDB).

Very truly yours,

R. K. M. Seto

R. K. M. Seto, Manager
Task E-99

B. Vaughn

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RMS:jc

RSP
RMD

cc: A. A. Bishop/KM2
R. H. Kohrs/WC
R. B. White/EP12

bcc: *W. L. Hussey
TRW Technical Library - HC

*Without attachment

NARA SW Box E209H-125

7/10 White

6531.11-73-54
25 June 1973
Re: Task E-99

National Aeronautics and Space Administration
Johnson Space Center
Houston, Texas 77058

Attention: Mr. F. D. Freeburn/EP2

Subject: Modifications to the Propulsion Analysis Trajectory Simulation Program to Incorporate a Two-Module Propulsion System Model

Reference: TRW IOC 6531.11-73-53, "Two-Pod Propulsion System Model," R. K. M. Seto and T. J. Walsh, 22 June 1973.

Gentlemen:

In order to provide the capability to simulate the operation of a two-module propulsion system, the Propulsion Analysis Trajectory Simulation (PATS) program was modified using engine information received from NASA/JSC. The reference (enclosed) documents the modifications made and discusses changes in program input and output. A formal PATS User's Manual Addendum will be published in the near future.

Very truly yours,

R. K. M. Seto

R. K. M. Seto, Manager
Task E-99

V. R. Widerquist

V. R. Widerquist, Manager
Spacecraft Systems Analysis Project

RKMS:jo

RKP

cc: A. A. Bishop/KM
J. C. Hooper/EP2
H. D. White/EP12

NARA SW Box E209H-125

20029-H156-R0-00

PROJECT TECHNICAL REPORT

APOLLO 16

LM-11

DESCENT PROPULSION SYSTEM FINAL FLIGHT EVALUATION

NAS 9-12330

JANUARY 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
A. T. Avvenire
Propulsion Systems Section
Applied Mechanics Department

TRW SYSTEMS

NARA SW Box E209H-125

20029-H160-R0-00

PROJECT TECHNICAL REPORT

APOLLO 16
CSM 113

SERVICE PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-12330

JANUARY 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
R. J. Smith
S. C. Wood
Applied Mechanics Section
Systems Evaluation Department

TRW SYSTEMS

NARA SW Box E209H-125

20029-H162-R0-00

PROJECT TECHNICAL REPORT

APOLLO 16

LM-11
ASCENT PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-12330

February 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
W. G. Griffin
Systems Evaluation Department

NARA SW Box E209H-125

20029-H177-R0-00

PROJECT TECHNICAL REPORT

TASK E-99

ADVANCED SPACECRAFT ORBIT MANEUVERING SYSTEM (OMS) DEVELOPMENT TEST PROGRAM GUIDELINE

NAS 9-12330

MARCH 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

Prepared by
Applied Mechanics Section
Systems Evaluation Department

TRW SYSTEMS

NARA SW Box E209H-125

20029-H175-R0-00

PROJECT TECHNICAL REPORT

STEADY-STATE SIMULATION PROGRAM FOR ATTITUDE CONTROL PROPULSION SYSTEMS

MSC/TRW TASK E-99

NAS 9-12330

MARCH 1973

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

Prepared by
P. J. Heinmiller
Applied Mechanics Section
Systems Evaluation Department

TRW
SYSTEMS GROUP

NARA SW Box E209H-125

20029-H197-R0-00

PROJECT TECHNICAL REPORT

ADDENDUM TO USER'S MANUAL FOR THE PROPULSION ANALYSIS TRAJECTORY SIMULATION PROGRAM

ORBITAL MANEUVERING SYSTEM

NAS 9-12330

June 1973

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
JOHNSON SPACE CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-125

20029-H130-R0-00

PROJECT TECHNICAL REPORT

APOLLO MISSION J3/LM-12/DPS
PREFLIGHT PERFORMANCE REPORT

NAS 9-12330 OCTOBER 1972

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
A. T. Avvenire
Propulsion Systems Section
Applied Mechanics Department

NARA SW Box E209H-125

2251-6028-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-1

FINAL ANALYSIS OF THE SERVICE MODULE RADIAL BEAM FAILURE DURING ACOUSTIC TESTING

Contract NAS 9-4810

16 May 1966

TRW SYSTEMS

NARA SW Box E209H-12

2251-6029-R0000

66.4016.0-42

PROGRAM TECHNICAL REPORT

TASK ASPO-17-1

FINAL ANALYSIS OF THE COMMAND MODULE - LUNAR EXCURSION MODULE INTERFACE LOAD DISTRIBUTION

Contract NAS 9-4810

16 May 1966

TRW SYSTEMS

NARA SW Box E209H-12

2251-6031-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-(7)

GENERALIZED FORCES FOR APOLLO SPACECRAFT ON SATURN V AND SATURN IB

NAS 9-4810

1 MAY 1966

TRW SYSTEMS

NARA SW Box E209H-12

2251-6032-R0000

PROGRAM TECHNICAL REPORT

Task ASPO - 17-5

ANALYTICAL TEST SOLUTION FOR THE STAB II CHARRING ABLATOR

15 June 1966

Prepared for
National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas
NAS 9-4810

Prepared by: A. S. Benjamin

Approved by: A. J. Rinaldi, Manager
Engineering Mechanics
Project Office, ASSAP

NARA SW Box E209H-12

2251-6033-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO 17-2

REVISION B DRAFT
LTA-8 TEST PLAN
THERMAL-VACUUM-MSC

CONTRACT NAS 9-4810

20 MAY 1966

YES
NO

ITT-FEC
Vanguard Bldg.
Record Copy

TRW SYSTEMS

NARA SW Box E209H-12

2251-6035-T0000

PROGRAM TECHNICAL REPORT

TASK ASPO-39

STRENGTH CAPABILITY OF THE BLOCK I LAUNCH ESCAPE SYSTEM/COMMAND MODULE INTERFACE

NAS 9-4810

1 JULY 1966

TRW SYSTEMS

NARA SW Box E209H-12

2251-6036-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17, SUBTASK 2

GUIDELINES FOR THE ESTABLISHMENT OF TEST RULES AND CRITERIA FOR THERMAL/VACUUM TEST PROGRAMS

NAS 9-4810

7 JUNE 1966

TRW SYSTEMS

NARA SW Box E209H-12

2251-6038-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-(4)

TRW SESL CHAMBER A

THERMAL ENVIRONMENT/008 SPACECRAFT COMPUTER PROGRAM

NAS 9-4810

30 June 1966

TRW SYSTEMS

NARA SW Box E209H-12

PROGRAM TECHNICAL REPORT

TASK ASPO-17-5

DESCRIPTION OF MODIFICATIONS MADE IN THE MSC STAB II CHARRING ABLATION PROGRAM

15 July 1966

Prepared for
National Aeronuatics and Space Administration
Manned Spacecraft Center
Houston, Texas
NAS 9-4810

Prepared By: A. S. Benjamin
A. H. Silver

Approved By:

A. J. Rinaldi, Manager
Apollo Engineering Operations
Department

NARA SW Box E209H-12

2251-6040-R0000

PROJECT TECHNICAL REPORT
TASK ASPO-39

COMMAND MODULE-SERVICE MODULE INTERFACE STRENGTH CAPABILITY, BLOCK II

NAS 9-4810

31 AUGUST 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-12

CAT.

2251-6027-R0000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-2

REVIEW OF APOLLO DOCKING TEST DEVICE TEST PROCEDURE

NAS 9-4810

8 APRIL 1966

*66-12113

TRW SYSTEMS

NARA SW Box E209H-12

2261-6007-TU-R01

APOLLO BLOCK I

TASK MSC/TRW ASPO-19

PROPULSION PERFORMANCE EVALUATION, MALFUNCTION CRITERIA AND FLIGHT DATA REQUIREMENTS REVISION I

NAS 9-4810

1 DECEMBER 1965

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TASK MSC/TRW ASPO-19

FLIGHT READINESS FIRING PROPULSION SYSTEM EVALUATION OF THE SERVICE MODULE OF SPACECRAFT 009

NAS 9-4810

30 DECEMBER 1965

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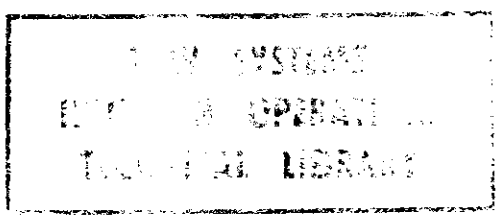
PROPULSION PERFORMANCE EVALUATION MALFUNCTION CRITERIA AND FLIGHT DATA REQUIREMENTS APPENDIX B—SPACECRAFT OII

NAS 9-4810

15 JANUARY 1966



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CONTRACT NO.
NAS 9-4810

DOCUMENT NO.
2261-6012-TO-000

PROPULSION TRAJECTORY SIMULATION PROGRAM

ANALYTICAL FORMULATION: Carol S. Powers

COMPUTER PROGRAMMING: Gordon Hull

27 January 1966

Prepared for
NASA Manned Spacecraft Center
Houston, Texas

APPROVED BY:

PROPULSION PERFORMANCE ANALYSIS:

G. J. MacLeod, Assistant Manager
Propulsion Operations Department

COMPUTER PROGRAMMING:

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Subsystems Programming Department

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2261-6014-T8000

APOLLO

TASK ASSAP 19-I

PERFORMANCE ANALYSIS AND INITIAL SPS ENGINE CHARACTERIZATION FOR TEST SERIES L AND M (AEDC PHASE II) (U)

NAS 9-4810

25 February 1966

CLASSIFICATION CHANGED TO Unclassified
By Authority of NASA letter BM-4 dtd 2/10/67
BY C Jakobert Date 9/26/67

TRW SYSTEMS

[redacted]

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Contract NAS 9-4810
2261-6022-T0000
30 March 1966

A Data User's Guide To Numerical Smoothing and Differentiation

or

Care and Feeding of Digital Filters

by

Mack Alford

APPROVED:

C. S. Powers

C. S. Powers, Head
Propulsion Systems Analysis Secti

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2261-6024-TO-000

19 May 1966

ADDITIONAL INSTRUMENTATION REQUIREMENTS FOR THE APOLLO SERVICE PROPULSION SYSTEM

Prepared Under Contract
NAS9-4810

Prepared by

T. H. Wilson

R. W. Burkhardt

APPROVED: D W Vernon

D. W. Vernon, Head
Propulsion Performance Analysis Section

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Redondo Beach,
California

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CONTRACT NO.
NAS 9-4810

DOCUMENT NO.
2261-6002-TU-000

GENERALIZED RETRIEVAL PROGRAM

INTRODUCTION: A. W. Parnell

COMPUTER PROGRAMMING: R. C. Rubinstein

12 October 1965

Prepared for

NASA Manned Spacecraft Center
Houston, Texas

APPROVED BY:

PROPULSION PERFORMANCE ANALYSIS:

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2261-6027-R0000

PROJECT TECHNICAL REPORT

TASK NO. ASPO 19-1

GENERAL STATISTICAL SUMMARY PROGRAM

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810
ASSAP

30 June 1966

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3150-H001-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-8

UPDATE TECHNIQUE FOR THE GEMINI VI RE-ENTRY BACKUP COMMANDS IN CASE OF A GUIDANCE AND COMMUNICATIONS FAILURE

NAS 9-4810

28 OCTOBER 1965

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NARA SW Box E209H-14

3150-H001-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-8

UPDATE TECHNIQUE FOR THE GEMINI VI AND GEMINI VII RE-ENTRY BACKUP COMMANDS IN CASE OF A GUIDANCE AND COMMUNICATIONS FAILURE

NAS 9-4810

20 December 1965

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
GEMINI MTCP

TRW SYSTEMS

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3150-H002-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-10

STATUS REPORT NO. 1
ON RE-ENTRY STUDIES FOR GT-7

11 November 1965

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
Contract NAS 9-4810
Gemini MTCP, Phase I

TRW SYSTEMS

NARA SW Box E209H-14

PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-11

REPORT I
TECHNICAL PLAN FOR THE MISSION PLANNING OF GEMINI 10

NAS 9-4810

15 December 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
GEMINI MTCP, PHASE I

TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-10

STATUS REPORT NO. 2
ON RE-ENTRY STUDIES FOR GT-7

26 November 1965

Prepared for
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HOUSTON, TEXAS
Contract NAS 9-4810
Gemini MTCP, Phase 1

TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-11

REPORT II
AGENA ORBITAL
PREDICTION REPORT

NAS 9-4810 21 January 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
GEMINI MTCP, PHASE II

TRW SYSTEMS

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3150-H004-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-10

FINAL REPORT ON
RE-ENTRY STUDIES FOR GT-7

NAS 9-4810

9 December 1965

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
Gemini MTCP

TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-11

REPORT III
PRELIMINARY AGENA 10 LAUNCH WINDOW ANALYSIS

20 January 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
Contract NAS 9-4810
GEMINI MTCP, PHASE I

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Task Manager

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TRW SYSTEMS

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3150-H007-R0-000

TRW NOTE NO. 66 FMT-403

PROJECT GEMINI
TASK MSC/TRW G-11

REPORT V
AGENA 10 LAUNCH WINDOW ANALYSIS

15 APRIL 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS
NAS 9-4810

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TRW SYSTEMS

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TRW NOTE NO. 66 FMT-421

PROJECT GEMINI

TASK MSC/TRW G-9

STATISTICAL TWO-IMPULSE PROCESSOR SUMMARY TECHNICAL REPORT

15 JUNE 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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HOUSTON, TEXAS
NAS 9-4810

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TRW SYSTEMS

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2261-6025-R0-001

PROJECT TECHNICAL REPORT

TASK ASPO 19-1

APOLLO PERFORMANCE ANALYSIS PROGRAM

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS
NAS 9-4810
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31 May 1966

FIRST REVISION: 6 July 1966

VELLUM

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TRW NOTE NO. 66 FMT-419

PROJECT GEMINI
TASK MSC/TRW G-11

ORBITAL AND RENDEZVOUS REPORT FOR GEMINI 10
REPORT IX

13 JUNE 1966

Prepared for
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NAS 9-4810

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-1

GEMINI MISSION GT-7 ORBITAL DEBRIS HAZARD EVALUATION

NAS 9-4810

22 NOVEMBER 1965

TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-1

GEMINI MISSION GT-8 ORBITAL DEBRIS HAZARD EVALUATION

1 MARCH 1966

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Gemini MTCP

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TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW G-1

GEMINI MISSION GT-8 ORBITAL DEBRIS HAZARD EVALUATION

NAS 9-4810

1 MARCH 1966

TRW SYSTEMS

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PROGRAM TECHNICAL REPORT

TASK MSC/TRW G-1

GEMINI MISSION GT-9 ORBITAL DEBRIS HAZARD EVALUATION

NAS 9-4810

10 MAY 1966

TRW SYSTEMS

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3150-6035-RO-001

PROGRAM TECHNICAL REPORT

TASK MSC/TRW G-1

SUPPLEMENT TO HAZARD EVALUATION GEMINI MISSION GT-9 ORBITAL DEBRIS

NAS 9-4810

13 MAY 1966

TRW SYSTEMS

5/20-11

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3150-6038-R0-000

TRW NOTE NO. 66 FMT-233

PROJECT GEMINI
TASK MSC/TRW G-11

GEMINI X ERROR ANALYSIS REPORT, DUAL RENDEZVOUS MISSION

15 JULY 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NAS 9-4810

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C. W. Pittman, Manager
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Mission Trajectory Control Program

TRW SYSTEMS

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3150-H010-R0-000

TRW NOTE NO. 66 FMT-422

PROJECT GEMINI
TASK MSC/TRW G-9

THE STATISTICAL TWO-IMPULSE PROCESSOR USER'S MANUAL

15 JUNE 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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MANNED SPACECRAFT CENTER
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NAS 9-4810

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Prepared by: James M. Moore
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TRW SYSTEMS

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3200-6001-RU000

BIMONTHLY PROGRESS REPORT
MISSION TRAJECTORY CONTROL PROGRAM
PROJECT APOLLO (PHASE II)

21 October 1964

PREPARED FOR THE NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

Under Contract No. NAS9-2938

Compiled by: E. A. Ward
E. A. Ward

Approved by: Edward M. Boughton
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Mission Trajectory Control
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PHASE I - TECHNICAL REPORT

EVALUATION OF AN ALTERNATE FLIGHT PLAN FOR LUNAR OPERATIONS

18 November 1964

Task MSC/STL A-12

PREPARED FOR THE NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

Under Contract No. NAS9-2938

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Task Manager

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Associate Manager
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TECHNICAL NOTE
GUIDANCE EQUATIONS
TASK MSC/STL A-1
LEM POWERED ASCENT ERROR ANALYSIS STUDY

16 November 1964

PREPARED FOR THE NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Under Contract No. NAS9-2938

Prepared by: B. B. White
B. B. White

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T. Magness
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TECHNICAL NOTE

TASK MSC/STL A-5

MINIMUM TIME TRAJECTORY BETWEEN TWO RADIUS VECTORS WITH LIMITED AMOUNT OF IMPULSE (U)

2 December 1964

PREPARED FOR THE NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

Under Contract No. NAS 9-2938
(Phase II)

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BIMONTHLY PROGRESS REPORT
MISSION TRAJECTORY CONTROL PROGRAM
PROJECT APOLLO (PHASES II AND IIa)

21 February 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

Contract NAS9-2938

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Director
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BIMONTHLY PROGRESS REPORT

MISSION TRAJECTORY CONTROL PROGRAM
PROJECT APOLLO (PHASE II)

NAS 9-2938

21 JUNE 1965

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BIMONTHLY PROGRESS REPORT

MISSION TRAJECTORY CONTROL PROGRAM
PROJECT APOLLO (PHASES II AND IIa)

NAS9-2938

21 APRIL 1965

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THOMPSON RAMO WOOLDRIDGE INC.

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APOLLO MISSION SA-206A
PRELIMINARY MISSION PROFILE (U)

VOLUME I

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract No. NAS9-2938
Phase II (Apollo)

Declassified to
ity of

31 March 1965

TRW SPACE TECHNOLOGY LABORATORIES
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3300-H005-RU000

APOLLO MISSION SA-501
PRELIMINARY SPACECRAFT
REFERENCE TRAJECTORY

VOLUME III

RADAR SIGHTING DATA

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract No. NAS9-2938
Phase II (Apollo)

15 MAY 1965

TRW SPACE TECHNOLOGY LABORATORIES
THOMPSON RAMO WOOLDRIDGE INC.

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3300-H009-RU000

APOLLO MISSION SA-206A SPACECRAFT PRELIMINARY REFERENCE TRAJECTORY

29 JULY 1965

VOLUME III
RADAR SIGHTING AND SPACECRAFT
LOOK ANGLE DATA

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract No. NAS 9-2938
Phase II (Apollo)

TRW SYSTEMS

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3300-H010-KU000

TECHNICAL NOTE

TASK MSC/TRW A-52

SPECIFICATION FOR LUNAR ORBIT RENDEZVOUS SIMULATION PROGRAM

26 July 1965

Prepared for the
National Aeronautics and Space Administration
Manned Spacecraft Center

Contract No. NAS9-2938
(Phase II)

TRW SYSTEMS

NARA SW Box E209H-16

3151-H001-T0-000

BIMONTHLY PROGRESS REPORT

GEMINI MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 June 1966

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3300-H015-RC000
Total Pages: 144

APOLLO MISSION AS-207A
PRELIMINARY MISSION PROFILE (U)

NAS 9-4810

16 SEPTEMBER 1965

VOLUME I
PROFILE DESCRIPTION

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract No. NAS 9-4810
Apollo MTCP

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E. A. Ward,
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TRW SYSTEMS

GROUP-4

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DECLASSIFIED AFTER 12 YEARS

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PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-7

APOLLO CIRCUMLUNAR ABORT GUIDANCE CAPABILITY

NAS 9-4810

31 AUGUST 1965

TRW SYSTEMS

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E. A. W.

TECHNICAL NOTE

SUMMARY OF ABORT MODES
TASK MSC/STL A-5

7 December 1964

PREPARED FOR THE NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Under Contract No. NAS9-2938
Phase II-Apollo

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TRW Space Technology Laboratories
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3400-6014-RU000

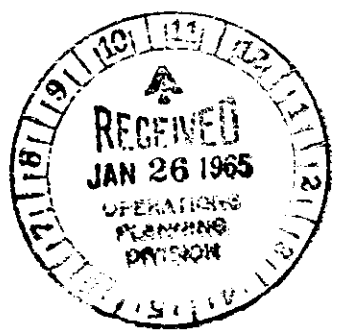
FINAL REPORT

TASK MSC / STL A-12

EVALUATION OF AN ALTERNATE FLIGHT PLAN FOR LUNAR OPERATION

NAS 9-2938

21 DECEMBER 1964



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THOMPSON RAMO WOOLDRIDGE INC.

NARA SW Box E209H-17

3400-6018-RU000

BIMONTHLY PROGRESS REPORT
MISSION TRAJECTORY CONTROL PROGRAM
PROJECT APOLLO
(PHASES II and IIa)

21 December 1964

PREPARED FOR THE NATIONAL
AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Under Contract No. NAS9-2938

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Apollo Program Manager (Los Angeles)
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TRW Space Technology Laboratories
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NARA SW Box E209H-17

3400-6025-RU000

INTERIM REPORT

TASK MSC/STL A-6

CALIBRATION OF ANALYTIC LUNAR PROGRAMS PHASES I AND II

NAS9-2938

15 FEBRUARY 1965

TRW SPACE TECHNOLOGY LABORATORIES

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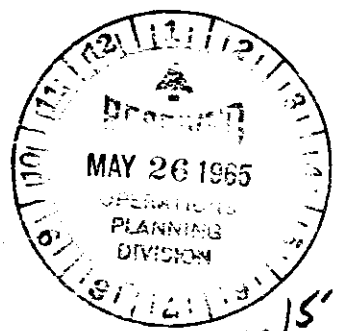
INTERIM REPORT

TASK MSC/STL A-31

FEASIBILITY OF HYBRID COMPUTATIONS FOR LUNAR MISSION PERFORMANCE EVALUATION

NAS 9-2938

25 MAY 1965



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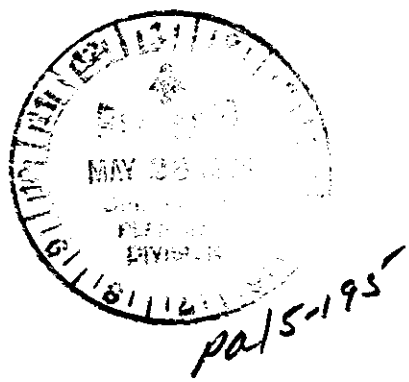
INTERIM REPORT

TASK MSC/STL A-42

DESCRIPTION OF NUTATION SUBROUTINE

NAS 9-2938

17 MAY 1965



TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOOLDRIDGE INC.

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3300-H014-RU000

AS-501 PRELIMINARY ALTERNATE MISSION AND ABORT PLAN

1 SEPTEMBER 1965

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract No. NAS 9-4810
Apollo MTCP

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JUN - 3 1965

3400-6040-RU000

FINAL REPORT
TASK MSC/STL A-35

PERFORMANCE REQUIREMENTS FOR OFF-NOMINAL LUNAR TRAJECTORIES

NAS9-2938

28 MAY 1965

TRW SPACE TECHNOLOGY LABORATORIES

NARA SW Box E209H-18

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3400-6041-RU001

FINAL REPORT
TASK MSC/STL A-39

SOLUTION OF THE EULER-LAGRANGE EQUATIONS DURING COAST PHASES

NAS9-2938

30 JULY 1965

TRW SYSTEMS

NARA SW Box E209H-18

3400-6045-RU000

SUMMARY TECHNICAL REPORT

TASK MSC/STL A-42

TRANSFORMATIONS INVOLVING THE SELENOGRAPHIC COORDINATE SYSTEM

NAS 9-2938

14 JUNE 1965

TRW SPACE TECHNOLOGY LABORATORIES

NARA SW Box E209H-18

3400-6048-TU000

SUMMARY TECHNICAL REPORT
TASK MSC/STL A-44

EFFECTS OF REAL TIME UPDATE OF LOI TARGETING

NAS 9-2938

25 JUNE 1965

TRW SPACE TECHNOLOGY LABORATORIES

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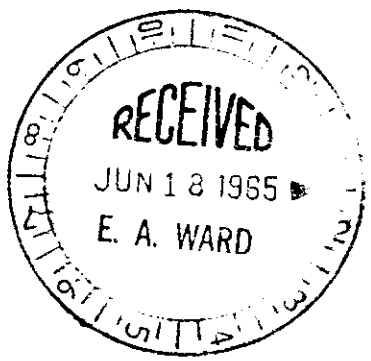
3400-6049-KU000

INTERIM REPORT
TASK MSC/STL A-41

APOLLO DIAGNOSTIC LOGIC STUDY

NAS 9-2938

JUNE 1965



TRW SPACE TECHNOLOGY LABORATORIES

NARA SW Box E209H-18

3400-6052-RU000

SUMMARY TECHNICAL REPORT
TASK MSC/STL A-37

COMPILATION OF A LIST OF TASK ASSIGNMENTS TO SUPPORT THE PRODUCTION OF THE MISSION TRAJECTORY DOCUMENTS

NAS 9-2938

5 JULY 1965

TRW SPACE TECHNOLOGY LABORATORIES

NARA SW Box E209H-18

3400-6055-KU000

TECHNICAL NOTE
TASK MSC/TRW A-2

LINEAR MONTE CARLO PROGRAM FOR THE LEM MIDCOURSE PHASE

NAS9-2938

20 JULY 1965

TRW SYSTEMS

NARA SW Box E209H-18

3400-6054-KU000

TECHNICAL NOTE
TASK MSC/TRW A-5

ABORT CHARACTERISTICS AND THEIR DISPLAY FOR PRIMARY APOLLO POWERED FLIGHT PHASES

NAS 9-2938

21 JULY 1965

TRW SYSTEMS

NARA SW Box E209H-18

Ref 9-208 Major Files

3400-6056-KU000

TECHNICAL NOTE
TASK MSC/TRW A-2

LINEAR MONTE CARLO PROGRAM FOR THE LEM TERMINAL RENDEZVOUS PHASE

NAS 9-2938

27 JULY 1965

TRW SYSTEMS

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3400-6039-KU000

TECHNICAL NOTE
TASK MSC/STL A-1

GUIDANCE EQUATIONS (REVISION NO. 1)

NAS 9-2938

2 JUNE 1965

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TECHNICAL NOTE
TASK MSC/TRW A-2

INTEGRATING MONTE CARLO PROGRAM FOR THE LEM MIDCOURSE PHASE

NAS 9-2938

3 AUGUST 1965

TRW SYSTEMS

NARA SW Box E209H-19

3400-6064-KU000

INTERIM REPORT
TASK MSC/TRW A-27

CSM RESCUE OF A "DEAD" LEM

NAS 9-2938

30 JULY 1965

*67-13969

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3400-6066-RU000

SUMMARY TECHNICAL REPORT

TASK MSC/TRW A-42

PLANETOCENTRIC COORDINATE TRANSFORMATIONS FOR THE PLANET MARS

NAS 9-2938

6 AUGUST 1965

TRW SYSTEMS

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DATA REQUIREMENTS FOR POST-FLIGHT ANALYSIS TASK FOR MISSIONS 201 AND 202

By

Evaluation Team

For Task MSC/STL A-50

4 August 1965

3400-6067-TU000

NAS9-2938

NARA SW Box E209H-19

3600-H001-SU000

BIMONTHLY PROGRESS REPORT

APOLLO SPACECRAFT

SYSTEM ANALYSIS PROGRAM

21 APRIL 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

Contract NAS9-2938

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BIMONTHLY PROGRESS REPORT

APOLLO SPACECRAFT

SYSTEM ANALYSIS PROGRAM

21 JUNE 1965

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TRW-9864.5.2-43

7-9-1965

PROJECT APOLLO

MISSION REQUIREMENTS
FOR
APOLLO SPACECRAFT DEVELOPMENT
MISSION 207A

Contract Number NAS 9-2038

Prepared by

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July 19, 1965

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TRW SYSTEMS

MISSION REQUIREMENTS

FOR

APOLLO SPACECRAFT DEVELOPMENT

APOLLO-SATURN 501/502

27 July 1965

Prepared for

Manned Spacecraft Center

National Aeronautics and Space Administration

Under Contract NAS9-2938

NARA SW Box E209H-19

PROJECT APOLLO

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION APOLLO - SATURN 501/502

REVISION 1

3 May 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Contract No. NAS 9-4810
MSC/TRW Task ASPO-13

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3640-6012-TU-000

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MISSION REQUIREMENTS

FOR

APOLLO SPACECRAFT DEVELOPMENT

MISSION 204A/205

30 AUGUST 1965

Prepared for

Manned Spacecraft Center

National Aeronautics and Space Administration

under

Contract Number NAS 9-4810

MSC/TRW Task ASPO-13

NARA SW Box E209H-19

Interim Report No. 2

RECOMMENDED APOLLO FLIGHT 202 SOFTWARE VALIDATION PLAN

Task 4, ASSAP, Contract NAS 9-2938

3730-6001-TU000 26 April 1965

RECEIVED
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TRW SPACE TECHNOLOGY LABORATORIES

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4 June 1965

FINAL REPORT, APOLLO GUIDANCE AND NAVIGATION TEST PROGRAM REVIEW

TRW/SPACE TECHNOLOGY LABORATORIES
Document No. 3730-6002-SU-000

Contract No. NAS 9-2938

Prepared for the
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SUMMARY TECHNICAL REPORT
TASK MSC/TRW A-42

DESCRIPTION OF TWO MODIFIED VERSIONS OF THE SELENOGRAPHIC COORDINATE TRANSFORMATION PROGRAM (PHASE I)

NAS 9-2938

21 JULY 1965

TRW SYSTEMS

NARA SW Box E209H-19

2101-H002-RU000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEM ANALYSIS PROGRAM

NAS 9-4810

31 August 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

TRW SYSTEMS

NARA SW Box E209H-1

2101-H003-RU000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

30 September 1965

Prepared for

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MANNED SPACECRAFT CENTER

TRW SYSTEMS

NARA SW Box E209H-1

2101-H004-SU000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

31 October 1965

Prepared for

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TRW SYSTEMS

NARA SW Box E209H-1

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2101-H005-SU000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

30 November 1965

Prepared for

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2101-H006-SU000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT

SYSTEMS ANALYSIS PROGRAM

31 December 1965

Prepared for

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NARA SW Box E209H-1

2101-H007-T0-000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

31 January 1966

Prepared for
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NARA SW Box E209H-1

2101-H008-T0-000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

28 February 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-1

2101-H009-T0-000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT

SYSTEMS ANALYSIS PROGRAM

31 MARCH 1966

Prepared for

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NARA SW Box E209H-1

2101-H010-T0-000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

30 APRIL 1966

Prepared for
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2101-H011-T0-000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT

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31 MAY 1966

Prepared for

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2101-H013-T0-000

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

30 JUNE 1966

Prepared for
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FINAL REPORT

APOLLO SPACECRAFT SPECIFICATION REVIEW

TRW SYSTEMS
ONE SPACE PARK • REDONDO BEACH, CALIFORNIA

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2122-6001-T0000

TASK ASPO-24

THERMAL RADIATION FROM SATURN FIREBALLS

NAS 9-4810

15 DECEMBER 1965

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FINAL REPORT

APOLLO SPACECRAFT
SYSTEM ANALYSIS PROGRAM

NAS 9-2938

1 August 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

TRW SYSTEMS

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3801-H003-SU-000

BI-MONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 DECEMBER 1965

TRW SYSTEMS

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3801-H005-T0-000

BI-MONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 February 1966

TRW SYSTEMS

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3801-H007-T0-000

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 April 1966

TRW SYSTEMS

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BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 June 1966

TRW SYSTEMS

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BIMONTHLY PROGRESS REPORT

MISSION TRAJECTORY CONTROL PROGRAM
PROJECT APOLLO (PHASE II)

21 AUGUST 1965

TRW SYSTEMS

NARA SW Box E209H-20

3801-6002-RU000

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

30 SEPTEMBER 1965

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3801-H002-RU000

FINAL REPORT

MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-2938

1 August 1965

Prepared for

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MANNED SPACECRAFT CENTER

TRW SYSTEMS

NARA SW Box E209H-20

3812-H001-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-14

TRANSLUNAR MIDCOURSE MANEUVER STRATEGY ANALYSIS

NAS 9-4810

18 OCTOBER 1965

VOLUME I
STOCHASTIC SIMULATION
AND ANALYSIS PROGRAM·

TRW SYSTEMS

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3812-H003-RU00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-30

COMPUTATION AND DISPLAY OF GO/NO-GO STATUS

22 OCTOBER 1965

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP

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TRW SYSTEMS

NARA SW Box E209H-21

3812-H003-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-30

COMPUTATION AND DISPLAY OF GO/NO-GO STATUS

NAS 9-4810

22 OCTOBER 1965

TRW SYSTEMS

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3812-H004-RUA01

SUMMARY TECHNICAL REPORT
TASK MSC/TRW A-30

EVALUATION OF GO/NO-GO DISPLAY FOR EARTH ORBIT INSERTION

1 DECEMBER 1965

ABRIDGEMENT

Prepared for
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Contract NAS 9-4810
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TRW SYSTEMS

NARA SW Box E209H-21

3812-H004-RU000

SUMMARY TECHNICAL REPORT
TASK MSC/TRW A-30

EVALUATION OF GO/NO-GO DISPLAY FOR EARTH ORBIT INSERTION

NAS 9-4810

1 DECEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-21

TRW NOTE NO. 66-FMT-404

PROJECT APOLLO
TASK MSC/TRW A-14

MIDCOURSE $\Delta\vec{V}$ PROGRAM

15 MARCH 1966

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

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PROJECT APOLLO
TASK MSC/TRW A-85

FINAL REPORT - INVESTIGATION OF LEM TRAJECTORY AND ATTITUDE CONSTRAINTS DUE TO S-BAND STEERABLE ANTENNA LIMITATIONS

30 MARCH 1966

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-21

PROJECT APOLLO
TASK MSC/TRW A-85

FINAL REPORT - INVESTIGATION OF LEM TRAJECTORY AND ATTITUDE CONSTRAINTS DUE TO S-BAND STEERABLE ANTENNA LIMITATIONS

30 MARCH 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-21

TRW NOTE NO. 66-FMT-406

PROJECT APOLLO
TASK MSC/TRW A-14

REAL-TIME MIDCOURSE MANEUVER FUNCTIONAL DISPLAY REQUIREMENTS

7 APRIL 1966

A B R I D G E M E N T

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 66-FMT-406

PROJECT APOLLO
TASK MSC/TRW A-14

REAL-TIME MIDCOURSE MANEUVER FUNCTIONAL DISPLAY REQUIREMENTS

7 APRIL 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-21

3812-H008-R0-00A

TRW NOTE NO. 66 FMT-411

PROJECT APOLLO
TASK MSC/TRW A-14

MIDCOURSE MANEUVER ANALYSIS FOR THE APOLLO LUNAR MISSION (U)

18 MAY 1966

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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3812-H009-R0-00A

TRW NOTE NO. 66 FMT-417

PROJECT APOLLO
TASK MSC/TRW A-14

PROGRAM USERS GUIDE FOR THE MIDCOURSE $\Delta\vec{V}$ PROGRAM

31 MAY 1966

ABRIDGEMENT

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TRW SYSTEMS

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MAR 1 1966

3812-6002-R0-000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-71

OPERATING INSTRUCTIONS FOR TAPP IV, TAPP III, LMCP, AND PROC

NAS 9-4810

21 FEBRUARY 1966

TRW SYSTEMS

NARA SW Box E209H-21

3812-6003 R0

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-71

OPERATING INSTRUCTIONS FOR INTEGRATING MONTE CARLO PROGRAM

NAS 9-4810

21 FEBRUARY 1966

TRW SYSTEMS

NARA SW Box E209H-21

TRW NOTE NO. 66 FMT-205

PROJECT APOLLO
TASK MSC/TRW A-71

STUDY OF VELOCITY PENALTIES ASSOCIATED WITH THE LEM CONENTRIC ASCENT PROFILE

7 MARCH 1966

Prepared for
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Mission Trajectory Control Program

TRW SYSTEMS

NARA SW Box E209H-21

TRW NOTE NO. 66 FMT-231

PROJECT APOLLO
TASK MSC/TRW A-84

RESULTS OF MISSION AS-503 TRAJECTORY PROGRAM VERIFICATION

27 JUNE 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

NARA SW Box E209H-21

TRW NOTE NO.66-FMT-424

PROJECT APOLLO
TASK MSC/TRW A-100

OPERATING INSTRUCTIONS FOR THE STOCHASTIC SIMULATION AND ANALYSIS PROGRAM

8 JULY 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

NARA SW Box E209H-21

3812-H001-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-14

TRANSLUNAR MIDCOURSE MANEUVER STRATEGY ANALYSIS

18 OCTOBER 1965

VOLUME I
STOCHASTIC SIMULATION
AND ANALYSIS PROGRAM

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract NAS 9-4810
Apollo MTCP

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TRW SYSTEMS

NARA SW Box E209H-21

3816-H002-RU000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-54

TECHNICAL APPROACH FOR APOLLO DISPERSION ANALYSIS

NAS 9-4810

1 FEBRUARY 1966

Prepared for
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MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP

TRW SYSTEMS

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3816-6001-KU000

TECHNICAL NOTE

TASK MSC/TRW A-54

LUNAR LANDING MISSION ERROR (DISPERSION) ANALYSIS

NAS 9-4810

2 AUGUST 1965

TRW SYSTEMS

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3816-6002-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-46

SERVICE MODULE PERFORMANCE SCAN FOR THE YEAR 1969

NAS 9-4810

12 OCTOBER 1965

TRW SYSTEMS

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3816-6002-RU00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-46

SERVICE MODULE PERFORMANCE SCAN FOR THE YEAR 1969

12 OCTOBER 1965

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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3816-6003-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-16

ORBIT EVALUATION AND MISSION PLANNING GUIDE

NAS 9-4810

5 DECEMBER 1965

VOLUME III
ELLIPTICAL ORBIT DATA
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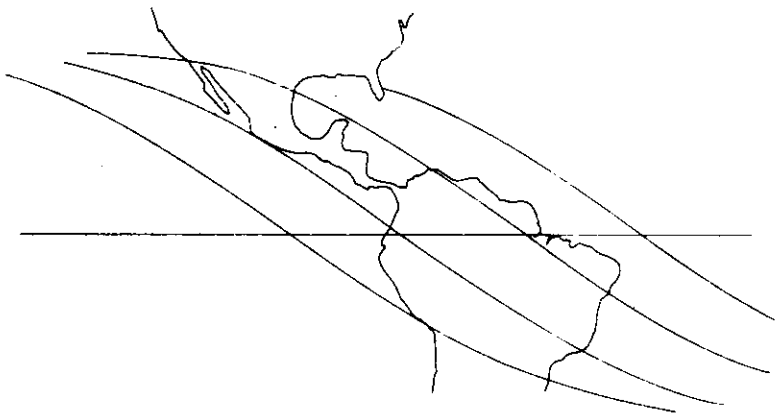

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-16

ORBIT EVALUATION AND MISSION PLANNING GUIDE

NAS 9-4810

5 DECEMBER 19

VOLUME IV
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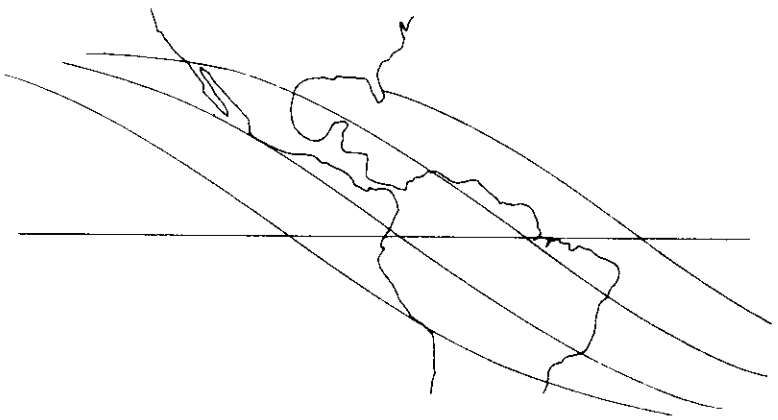

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NARA SW Box E209H-22

3816-H002-RU00A

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-54

TECHNICAL APPROACH FOR APOLLO DISPERSION ANALYSIS

1 FEBRUARY 1966

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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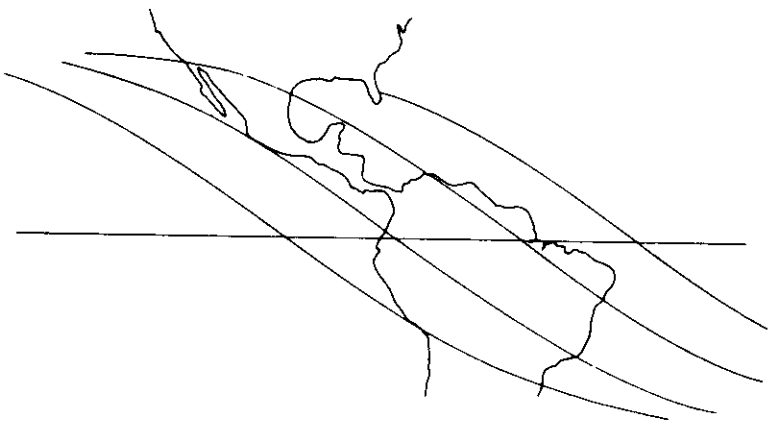
3816-6006-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-16

ORBIT EVALUATION AND MISSION PLANNING GUIDE

5 DECEMBER 1965

VOLUME VI
ELLIPTICAL ORBIT DATA
110 N MI PERIGEE ALTITUDE



TRW SYSTEMS

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3816-6007-R0-000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-53

PERFORMANCE EVALUATION FOR OFF-NOMINAL APOLLO LUNAR PARKING ORBITS

NAS 9-4810

20 DECEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-23

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-53

PERFORMANCE EVALUATION FOR OFF-NOMINAL APOLLO LUNAR PARKING ORBITS

20 DECEMBER 1965

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-53

OFF-NOMINAL PERFORMANCE AND TARGETING ANALYSIS FOR APOLLO LUNAR OPERATIONS

15 JANUARY 1966

ABRIDGEMENT

Prepared for
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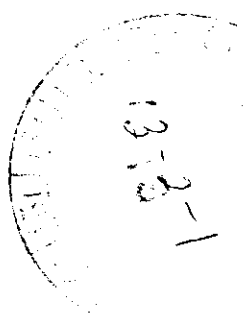
3816-6008-R0-000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-53

OFF-NOMINAL PERFORMANCE AND TARGETING ANALYSIS FOR APOLLO LUNAR OPERATIONS

NAS 9-4810

15 JANUARY 1966



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3816-6009-R0-000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-68

PAYLOAD ADVANTAGES WITH EARTH ELLIPTICAL PARKING ORBITS FOR THE APOLLO MISSION

NAS 9-4810

11 FEBRUARY 1966

TRW SYSTEMS

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3816-6005-RU00

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-16

ORBIT EVALUATION AND MISSION PLANNING GUIDE

NAS 9-4810

5 DECEMBER 196

VOLUME V
ELLIPTICAL ORBIT DATA
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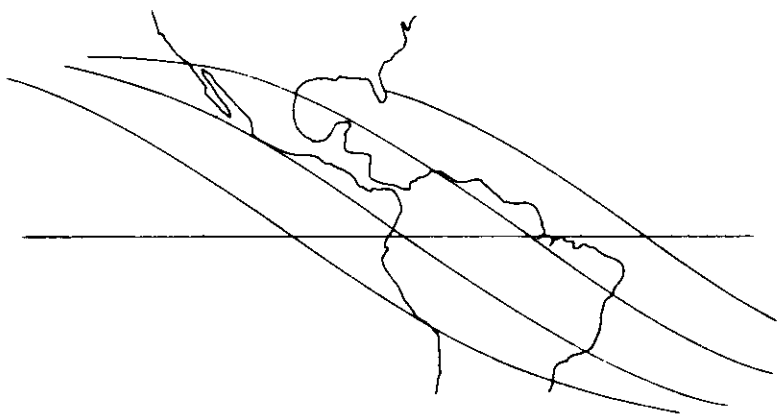

TRW SYSTEMS

NARA SW Box E209H-23

TRW NOTE NO. 66 FMT-214

PROJECT APOLLO
TASK MSC/TRW A-46

PARAMETRIC PERFORMANCE SCAN OF LUNAR SURFACE ACCESSIBILITY FOR JANUARY 1969

9 MAY 1966

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-24

TRW NOTE NO. 66 FMT-226

PROJECT APOLLO
TASK MSC/TRW A-66

PARAMETRIC STUDY TO DEFINE THE APOLLO ENTRY CORRIDOR

30 MAY 1966

Prepared for
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TRW SYSTEMS

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3822-H001-RU A01

GENERAL APOLLO LAUNCH PHASE TRAJECTORY STUDY

2 DECEMBER 1965

A B R I D G E M E N T

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TRW SYSTEMS

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3822-H001-RU000

GENERAL APOLLO LAUNCH PHASE TRAJECTORY STUDY

2 DECEMBER 1965

VOLUME I
DATA ANALYSIS

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Contract NAS 9-4810
Apollo MTCP

TRW SYSTEMS

NARA SW Box E209H-24

3822-H002-RU000

GENERAL APOLLO LAUNCH PHASE TRAJECTORY STUDY

2 DECEMBER 1965

VOLUME II
DISCRETE EVENTS SUMMARIES

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP

TRW SYSTEMS

NARA SW Box E209H-24

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-60

APOLLO REAL TIME DISPLAY CANDIDATES FOR EARTH RETURN ORBITS–INTERIM REPORT

7 JANUARY 1966

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-24

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-60

APOLLO REAL TIME DISPLAY CANDIDATES FOR EARTH RETURN ORBITS—INTERIM REPORT

NAS 9-4810

7 JANUARY 1966

TRW SYSTEMS

NARA SW Box E209H-24

3822-H004-RU-000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-60

ABORT PROGRAM
EARTH PHASE TEST PLAN RESULTS

NAS 9-4810

28 JANUARY 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP

TRW SYSTEMS

NARA SW Box E209H-24

3822-H005-R0-00A

TRW NOTE NO. 66 FMT-405

PROJECT APOLLO
TASK MSC/TRW A-60.3

APOLLO LUNAR LANDING MISSIONS OPERATIONAL ABORT ANALYSIS - INTERIM REPORT

31 MARCH 1966

ABRIDGEMENT

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-24

3822-H005-R0-000

TRW NOTE NO. 66 FMT-405

PROJECT APOLLO
TASK MSC/TRW A-60.3

APOLLO LUNAR LANDING MISSIONS OPERATIONAL ABORT ANALYSIS - INTERIM REPORT

31 MARCH 1966

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 66 FMT-214

PROJECT APOLLO
TASK MSC/TRW A-46

PARAMETRIC PERFORMANCE SCAN OF LUNAR SURFACE ACCESSIBILITY FOR JANUARY 1969

9 MAY 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-24

3822-H007-R0-00A

TRW NOTE NO. 66-FMT-426

PROJECT APOLLO
TASK MSC/TRW A-60.3

APOLLO LUNAR LANDING MISSIONS OPERATIONAL ABORT DISPLAYS AND PROCEDURES VOLUME I: EARTH PHASE REQUIREMENTS

ABRIDGEMENT

Prepared by
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15 JULY 1966

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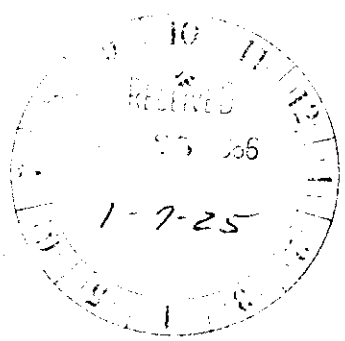

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TRW SYSTEMS

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TRW NOTE NO. 66-FMT-426

PROJECT APOLLO
TASK MSC/TRW A-60.3

APOLLO LUNAR LANDING MISSIONS
OPERATIONAL ABORT DISPLAYS AND PROCEDURES
VOLUME I: EARTH PHASE REQUIREMENTS

15 JULY 1966

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TRW SYSTEMS

NARA SW Box E209H-25

3822-6001-RU000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-29

ABORT FROM NON-FREE RETURN LUNAR TRAJECTORIES

NAS 9-4810

20 AUGUST 1965

TRW SYSTEMS

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3822-6002-RU000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-26

EVALUATION OF MANUAL POWERED MANEUVERS FOR APOLLO COMMAND AND SERVICE MODULE

NAS 9-4810

31 AUGUST 1965

TRW SYSTEMS

NARA SW Box E209H-25

Cat

3822-6002-RU001

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-26

ADDENDUM TO EVALUATION OF MANUAL POWERED MANEUVERS FOR APOLLO COMMAND AND SERVICE MODULE

NAS 9-4810

19 OCTOBER 1965

TRW SYSTEMS

NARA SW Box E209H-25

3822-6003-RU00A

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-5

ABORT ANALYSIS OF PRIMARY POWERED FLIGHT PHASES OF MANNED APOLLO MISSIONS

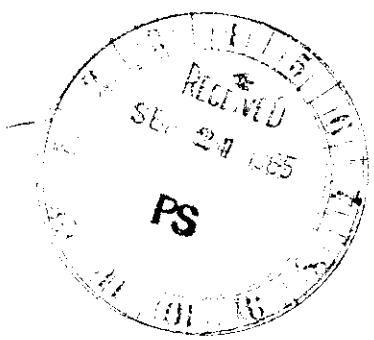
9 SEPTEMBER 1965

Volume I

DATA DISPLAY

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP



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TRW SYSTEMS

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3822-6003-RU000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-5

ABORT ANALYSIS OF PRIMARY POWERED FLIGHT PHASES OF MANNED APOLLO MISSIONS

NAS 9-4810

9 SEPTEMBER 1965

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TRW SYSTEMS

NARA SW Box E209H-25

3822-6004-RU00A

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-5

ABORT ANALYSIS OF PRIMARY POWERED FLIGHT PHASES OF MANNED APOLLO MISSIONS

9 SEPTEMBER 1965

Volume II

TECHNICAL APPROACH

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-25

3822-6004-RU000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-5

ABORT ANALYSIS OF PRIMARY POWERED FLIGHT PHASES OF MANNED APOLLO MISSIONS

NAS 9-4810

9 SEPTEMBER 1965

Volume II

TECHNICAL APPROACH

TRW SYSTEMS

NARA SW Box E209H-25

3822-H006-R0-000

TRW NOTE NO. 66-FMT- 410

PROJECT APOLLO

ABORT PROGRAM MOON PHASE TEST PLAN RESULTS

27 APRIL 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-25

3822-6006-R0-000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-60

FIRST INTERIM STATUS REPORT FOR LUNAR LANDING MISSIONS ABORT ANALYSES

10 DECEMBER 1965

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-26

3822-6007-R0000
Contract No. NAS9-4810
14 January 1966

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TRW NOTE NO. 66-FMT-213

PROJECT APOLLO
TASK MSC/TRW A-81

DEVELOPMENT OF A MISSION ANALYSIS PROGRAM

April 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-26

TRW NOTE NO. 66 FMT-215

PROJECT APOLLO
TASK MSC/TRW A-60.2

SECOND INTERIM STATUS REPORT FOR LUNAR LANDING MISSIONS ABORT ANALYSES

3 MAY 1966

Prepared for
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Mission Trajectory Control Program

TRW SYSTEMS

NARA SW Box E209H-26

TRW NOTE NO. 66 FMT-220

PROJECT APOLLO
TASK MSC/TRW A-60.5

APOLLO LUNAR LANDING ONBOARD MANUAL ABORT ANALYSIS——INTERIM REPORT

2 MAY 1966

ABRIDGEMENT

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

Prepared by: L. W. Diamant
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TRW SYSTEMS

NARA SW Box E209H-26

TRW NOTE NO. 66 FMT-220

PROJECT APOLLO
TASK MSC/TRW A-60.5

APOLLO LUNAR LANDING ONBOARD MANUAL ABORT ANALYSIS——INTERIM REPORT

2 MAY 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-26

3828-6001-R0-00A

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-32

EVALUATION OF POSSIBLE FLIGHT PLAN FOR LUNAR LANDING MISSION

15 JANUARY 1966

ABRIDGEMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

Contract NAS 9-4810

Apollo MTCP

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Approved by: R W Johnson
for J. G. Reid, Assistant Director
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Mission Trajectory Control Program

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3828-6001-R0-000

PROGRAM TECHNICAL REPORT

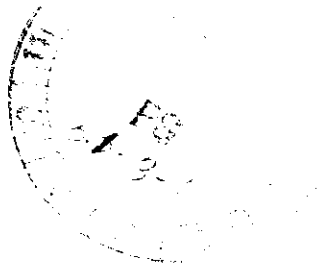
TASK MSC/TRW A-32

EVALUATION OF POSSIBLE FLIGHT PLAN FOR LUNAR LANDING MISSION

NAS 9-4810

15 JANUARY 1966

TRW SYSTEMS



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TRW NOTE NO. 66 FMT-232

PROJECT APOLLO
TASK MSC/TRW A-32

EVALUATION OF ALTERNATE TRANSLUNAR FLIGHT PLANS FOR THE LUNAR LANDING MISSION

15 JULY 1966

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-26

TRW NOTE NO. 66 FTM-207

PROJECT APOLLO
TASK MSC/TRW A-32

USER'S MANUAL FOR THE HIGH ELLIPSE ANALYTIC LUNAR COMPUTER PROGRAM (HEALP) (PRELIMINARY VERSION)

8 MARCH 1966

ABRIDGEMENT

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-26

TRW NOTE NO. 66 FMT-207

PROJECT APOLLO
TASK MSC/TRW A-32

USER'S MANUAL FOR THE HIGH ELLIPSE ANALYTIC LUNAR COMPUTER PROGRAM (HEALP) (PRELIMINARY VERSION)

8 MARCH 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-26

TO: Distribution CC: DATE: 15 December 1965

SUBJECT: Revision of Appendix to Task A-60 Technical Report

FROM: H. A. Lieske

BLDG. TR-3 ROOM 3239 EXT. 254

REFERENCE: "Final Interim Status Report for Lunar Landing Missions Abort Analysis," by H. A. Lieske, Interim Status Report for Task MSC/TRW A-60, 3822-6006-R0-000, 10 December 1965.

Attached are pages 61-69 which contain the appendix to the above report. These revised pages present the abort trajectory parameters in e-TCA graphs for the delay time interval from 0 to 60 minutes to the same scale as the figures contained in Section 2 to facilitate comparison with that longer delay time data.

HAL/gm
Attachments (9)

NARA SW Box E209H-26

3832-H004-R0-00A

TRW NOTE NO. 66-FMT-408

PROJECT APOLLO
TASK MSC/TRW A-77

EMPIRICAL SIMULATION OF THE TRANSLUNAR INJECTION BURN

6 APRIL 1966

ABRIDGEMENT

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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P.M.

TRW SYSTEMS

NARA SW Box E209H-27

PROJECT APOLLO
TASK MSC/TRW A-51

FINAL REPORT - LEM LUNAR LAUNCH PLANNING DISPLAY PROCESSOR LOGIC

Prepared by J. L. Knoedler
Guidance and Analysis Department
TRW Systems

15 FEBRUARY 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Mission Trajectory Control Program

TRW SYSTEMS

NARA SW Box E209H-27

PROJECT APOLLO
TASK MSC/TRW A-51

FINAL REPORT - LEM LUNAR LAUNCH PLANNING DISPLAY PROCESSOR LOGIC (REVISION 1)

Prepared by J. L. Knoedler
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29 APRIL 1966

Prepared for
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Mission Trajectory Control Program

TRW SYSTEMS

NARA SW Box E209H-27

3838-H005-RU-00A

TRW NOTE NO. 66 FMT-409

PROJECT APOLLO
TASK MSC/TRW A-11

COMPARISON STUDY TO VERIFY THE FREE-FLIGHT PORTION OF THE APOLLO REFERENCE MISSION PROGRAM

6 MAY 1966

A B R I D G E M E N T

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACEFLIGHT CENTER
HOUSTON, TEXAS
NAS 9-4810

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Mission Trajectory Control Program

TRW SYSTEMS

NARA SW Box E209H-27

3838-H005-RU-000

TRW NOTE NO. 66 FMT-409

PROJECT APOLLO
TASK MSC/TRW A-11

COMPARISON STUDY TO VERIFY THE FREE-FLIGHT PORTION OF THE APOLLO REFERENCE MISSION PROGRAM

6 MAY 1966

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACEFLIGHT CENTER
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Mission Trajectory Control Program

TRW SYSTEMS

NARA SW Box E209H-27

TRW NOTE NO. 66 FMT-413

PROJECT APOLLO
TASK MSC/TRW A-63

MODIFICATIONS TO THE MSC GENERALIZED FORWARD ITERATOR

24 MAY 1966

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS
NAS 9-4810

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Approved by: R. W. Johnson
for J. G. Reid, Manager
Mission Analysis and Design
Mission Trajectory Control Program

TRW SYSTEMS

NARA SW Box E209H-27

APOLLO TRAJECTORY DESIGN PROGRAM

NAS 9-4810

10 DECEMBER 1966

USERS MANUAL

Mission Analysis Branch
Mission Planning and Analysis Division
MANNED SPACECRAFT CENTER
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HOUSTON, TEXAS

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L. L. Lakamp, Task Manager
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Program

TRW SYSTEMS

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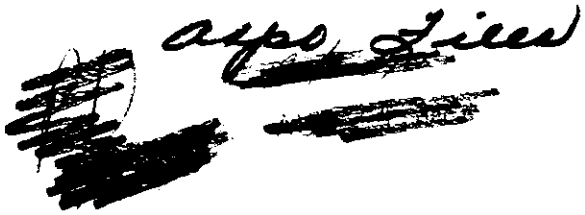

3832-6002-RU000

SUMMARY TECHNICAL REPORT

TASK MSC/TRW A-6

CALIBRATION OF ANALYTIC LUNAR PROGRAMS

NAS 9-4810

15 AUGUST 1965

TRW SYSTEMS

NARA SW Box E209H-28

3832-6003-RU000

SUMMARY TECHNICAL REPORT

TASK MSC/TRW A-27

CSM RESCUE OF A "DEAD" LEM

NAS 9-4810

19 AUGUST 1965

TRW SYSTEMS

NARA SW Box E209H-28

3832-6005-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-41

APOLLO DIAGNOSTIC LOGIC STUDY

20 SEPTEMBER 1965

Volume I
SUMMARY

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP

Prepared by: _____
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Approved by: _____
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TRW SYSTEMS

NARA SW Box E209H-28

PS 2/S-1564
9/30/65

3832-6006-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-41

APOLLO DIAGNOSTIC LOGIC STUDY

NAS 9-4810

20 SEPTEMBER 1965

Volume II
DETAILED SUBSYSTEM ANALYSES

(PART 1)

TRW SYSTEMS

NARA SW Box E209H-28

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9166/65

3832-6006-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-41

APOLLO DIAGNOSTIC LOGIC STUDY

NAS 9-4810

20 SEPTEMBER 1965

Volume II
DETAILED SUBSYSTEM ANALYSES

(PART 2)

TRW SYSTEMS

NARA SW Box E209H-28

DATA PROCESSING REQUIREMENTS FOR ESTIMATING APOLLO SYSTEMS PERFORMANCE IN REAL TIME

Task MSC/TRW A-41

By

Robert Nock

5 August 1965

3832-6001-TU000

NAS9-2938

TRW/SYSTEMS

NARA SW Box E209H-28

3832-6009-RU00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-28

PROGRAM GUIDE FOR THE ABØRT PROGRAM (PRELIMINARY VERSION)

NAS 9-4810

29 OCTOBER 1965

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP

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Mission Trajectory Control Program

TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-28

PROGRAM GUIDE FOR THE ABØRT PROGRAM (PRELIMINARY VERSION)

NAS 9-4810

29 OCTOBER 1965

TRW SYSTEMS

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3832-6010-R0-00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-27

CSM RESCUE OF A "DEAD" LEM UTILIZING COELLIPTIC PHASING ORBIT

24 JANUARY 1966

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract NAS 9-4810
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TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-27

CSM RESCUE OF A "DEAD" LEM UTILIZING COELLIPTIC PHASING ORBIT

NAS 9-4810

24 JANUARY 1966

TRW SYSTEMS

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TRW NOTE NO. 66 FMT-219

PROJECT APOLLO
TASK MSC/TRW A-80

A SOLUTION OF THE VARIATIONAL AND ADJOINT EQUATIONS DURING COAST PHASES VIA UNIVERSAL VARIABLES

27 APRIL 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

NARA SW Box E209H-29

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3832-6013-R0-RD1

TRW NOTE NO. 66 FMT-227

PROJECT APOLLO
TASK MSC/TRW A-81.1

OFF-NOMINAL LUNAR OPERATIONS PERFORMANCE EVALUATION FOR CIRCULAR LUNAR PARKING ORBITS - INTERIM REPORT

Prepared by
Orbital Systems Section
TRW Systems

30 MAY 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-29

TRW NOTE NO. 66 FMT-229

PROJECT APOLLO
TASK MSC/TRW A-81.2

PERFORMANCE EVALUATION PROGRAM USER'S MANUAL

28 JUNE 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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TRW SYSTEMS

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TRW NOTE NO. 66 FMT-227

PROJECT APOLLO
TASK MSC/TRW A-81.1

PERFORMANCE EVALUATION OF OFF-NOMINAL CIRCULAR LUNAR PARKING ORBITS—INTERIM REPORT

10 JULY 1966

Prepared for
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TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-39

NUMERICAL VERIFICATION OF SOLUTION OF EULER-LAGRANGE EQUATIONS DURING COAST

NAS 9-4810

20 OCTOBER 1965

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PROJECT TECHNICAL REPORT
TASK ASPO-33

APOLLO SPACECRAFT PRELAUNCH CONDITIONING SPACECRAFT 011

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

15 March 1966

TRW SYSTEMS

NARA SW Box E209H-2

2124-H001-R0-000

A SYSTEMS STUDY OF A MAXIMUM RCS PROPELLANT RESERVE PROFILE FOR THE SA-504A MISSION

25 MARCH 1966

TRW SYSTEMS

NARA SW Box E209H-2

2124-H002-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO - 15A

APOLLO SPACECRAFT CRITICAL DESIGN PARAMETERS EVALUATION - COMMUNICATIONS CAPACITY SUBTASK 7 INTERIM REPORT

NAS 9-4810

23 MAY 1966

TRW SYSTEMS

NARA SW Box E209H-2

2124-H003-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO-15

APOLLO MISSION-278 FLIGHT PLAN AND COMPATIBILITY ANALYSIS

NAS 9-4810

15 JULY 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-2

PROJECT TECHNICAL REPORT
TASK ASPO-15

APOLLO MISSION-278 FLIGHT PLAN AND COMPATIBILITY ANALYSIS ADDENDUM NUMBER 1

NAS 9-4810

1 SEPTEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-2

2124-H004-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO-15

PROGRAM FOR THE ANALYSIS OF ELECTRICAL SYSTEM OPERATIONS

NAS 9-4810

30 JULY 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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TRW SYSTEMS

NARA SW Box E209H-2

2124-6002-R0-000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15A (SUBTASK 2)

PROGRAM MODIFICATION STUDY REPORT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NAS 9-4810

14 MARCH 1966

TRW SYSTEMS

NARA SW Box E209H-2

PROJECT TECHNICAL REPORT

TASK NO. ASPO-12 (STAGING SUBTASK)

FINAL REPORT ON STAGING ANALYSES

Prepared for:
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810
ASSAP

15 June 1966

TRW SYSTEMS

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2131-H002-T8-000
Total Pages: 88

APOLLO MISSION DATA SPECIFICATION B

APOLLO SATURN 504 AND SUBSEQUENT MISSIONS (U)

MAR 1 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Contract No. NAS 9-4810

Approved by: _____
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Apollo Spacecraft System
Analysis Program Office
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Approved by: _____
O. E. Maynard, Chief
Systems Engineering Division
Apollo Spacecraft Program Office
NASA/MSC

Declassified to Unclass
by authority of Lt. D.E. Ezquerra
NASA-SCB 7/1/70
this date 6/16/71

GROUP-4
DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS

TRW SYSTEMS

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2131-H002-TJ-000

OPTIONAL FORM NO 10
MAY 1962 EDITION
GSA GEN. REG. NO. 27

5010-107

UNITED STATES GOVERNMENT

Memorandum

TO : Distribution

DATE: MAY 2 1966

In reply refer to: PM2-M54

FROM : PM/Chief, Mission Operations Division
Apollo Spacecraft Program Office

SUBJECT: Mission AS-504, Revision to Apollo Mission Data Specification (AMDS) "B"

The following mass properties data revisions are for incorporation into the subject AMDS with Tables 3-1, 3-2, and 3-5 attached hereto.

These changes reflect a re-distribution of the Lunar Excursion Module (LEM) weights recently agreed upon between MSC and GAEC, and will soon be formally identified as LEM control weights.

Owen E. Maynard

Enclosure

Distribution: (Same as Data Specification Distribution)

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2131-H003-T8-000

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Total Pages: 81

APOLLO MISSION DATA SPECIFICATION B

APOLLO SATURN 278A (U)

MAR 1 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract No. NAS 9-4810

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Apollo Spacecraft Systems
Analysis Program Office
TRW Systems

Approved by: _____
O. E. Maynard, Chief
Systems Engineering Division
Apollo Spacecraft Program Office
NASA/MSC

Reclassified to Unclass
by authority of Dr. J. E. Smart
NASA-SCB 7/1/70
this date 6/11/61 JM

GROUP-4
DOWNGRADED AT 3 YEAR INTERVALS;
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TRW SYSTEMS

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2131-H004-R8-000
Total Pages: 107

APOLLO MISSION DATA SPECIFICATION D

APOLLO SATURN 204A AND 204B (U)

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Contract No. NAS 9-4810

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Approved by: O.E. Maynard

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NASA/MSC

Reclassified to Unclass
by authority of Ltr, J.E. Smart
NASA-SCB, 2/1/70
this date 6/16/71 Jm

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DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS

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GROUP 4

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DECLASSIFIED AFTER 12 YEARS

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APOLLO MISSION DATA SPECIFICATION C

APOLLO SATURN 207/208A (U)

Prepared for

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Contract No. NAS 9-4810

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Reclassified to Unclass
by authority of Thos E Smart
NASA-SEC 7/1/70
this date 6/16/71 jm

GROUP-4
DOWNGRADED AT 3 YEAR INTERVALS;
DECLASSIFIED AFTER 12 YEARS

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2123-H001-RO-000

PROJECT TECHNICAL REPORT
TASK ASPO-33

APOLLO SPACECRAFT PRELAUNCH CONDITIONING
BLOCK I - LC34

NAS 9-4810

25 JULY 1965

Prepared for
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MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-2

3838-H002-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-11

EVALUATION OF ARMP PERTURBATION CALCULATION AND SELENOGRAPHIC VELOCITY TRANSFORMATION

NAS 9-4810

3 DECEMBER 1965

Prepared for
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MANNED SPACECRAFT CENTER
Contract NAS 9-4810
Apollo MTCP

TRW SYSTEMS

NARA SW Box E209H-30

3838-H003-RU10A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-11

APOLLO REFERENCE MISSION PROGRAM ITERATIVE GUIDANCE SCHEME

15 DECEMBER 1965

ABRIDGEMENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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TRW SYSTEMS

NARA SW Box E209H-30

3838-H003-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-11

APOLLO REFERENCE MISSION PROGRAM ITERATIVE GUIDANCE SCHEME

NAS 9-4810

15 DECEMBER 1965

Prepared for
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Apollo MTCP

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PROJECT APOLLO
TASK MSC/TRW A-51

★ 66-1211

FINAL REPORT - LEM LUNAR LAUNCH PLANNING DISPLAY PROCESSOR LOGIC

Prepared by J. L. Knoedler
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SUPERSEDED
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SAVE FOR CONFIGURATION ONLY

15 FEBRUARY 1966

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TRW SYSTEMS

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3838-H007-R0-000

APOLLO REENTRY SIMULATION PROGRAM

NAS 9-4810

3 JUNE 1966

Prepared for
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WORKING PAPER

NARA SW Box E209H-30

3838-6001-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-42

DESCRIPTION OF THE PLANETARY SEPARATION SUBROUTINE

NAS 9-4810

17 AUGUST 1965

TRW SYSTEMS

NARA SW Box E209H-30

3838-6002-RU00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-42

ON THE SELECTION OF A SELENOGRAPHIC COORDINATE TRANSFORMATION PACKAGE FOR A TRAJECTORY INTEGRATION PROGRAM

1 OCTOBER 1965

ABRIDGEMENT

Prepared for
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3838-6002-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-42

ON THE SELECTION OF A SELENOGRAPHIC COORDINATE TRANSFORMATION PACKAGE FOR A TRAJECTORY INTEGRATION PROGRAM

NAS 9-4810

1 OCTOBER 1965

TRW SYSTEMS

NARA SW Box E209H-30

3838-6004-R0-001

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-48

ADDENDUM—STUDY OF MISSION AS-206 ATTITUDE DETERMINATION ACCURACY USING MSFN TRACKING DATA

NAS 9-4810

13 JANUARY 1966

TRW SYSTEMS

NARA SW Box E209H-30

3838-6007-RU00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-48

PROGRAM FOR PROPAGATING INITIAL ERROR COVARIANCE MATRICES THROUGH POWERED FLIGHT MANEUVERS

15 NOVEMBER 1965

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-48

CHECKOUT AND VERIFICATION OF PROGRAM A-48A (U)

15 NOVEMBER 1965

ABRIDGEMENT

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TRW SYSTEMS

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3838-6011-R0-00A

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-48

COMPUTER PROGRAM FOR APOLLO C-BAND DATA PROCESSOR

3 FEBRUARY 1966

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-48

COMPUTER PROGRAM FOR APOLLO C-BAND DATA PROCESSOR

NAS 9-4810

3 FEBRUARY 1966

TRW SYSTEMS

NARA SW Box E209H-30

3838-6012-R0-00A

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-48

USER'S MANUAL FOR APOLLO C-BAND DATA PROCESSOR

15 FEBRUARY 1966

ABRIDGEMENT

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3838-6012-R0-000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-48

USER'S MANUAL FOR APOLLO C-BAND DATA PROCESSOR

15 FEBRUARY 1966

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3838-6013-R0-00A

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-48

MATHEMATICAL MODEL FOR ESTIMATION OF POWERED (AND FREE FLIGHT) TRAJECTORIES IN THE EARTH-MOON GRAVITY FIELD

15 FEBRUARY 1966

ABRIDGEMENT

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3838-6013-R0-000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-48

MATHEMATICAL MODEL FOR ESTIMATION OF POWERED (AND FREE FLIGHT) TRAJECTORIES IN THE EARTH-MOON GRAVITY FIELD

NAS 9-4810

15 FEBRUARY 1966

TRW SYSTEMS

NARA SW Box E209H-30

TRW NOTE NO. 66 FMT-212

PROJECT APOLLO
TASK MSC/TRW A-48

PROGRAM FOR PROPAGATING INITIAL ERROR COVARIANCE MATRICES THROUGH POWERED FLIGHT MANEUVERS (REVISION)

6 APRIL 1966

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 66 FMT-212

PROJECT APOLLO
TASK MSC/TRW A-48

PROGRAM FOR PROPAGATING INITIAL ERROR COVARIANCE MATRICES THROUGH POWERED FLIGHT MANEUVERS (REVISION)

6 APRIL 1966

Prepared for
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R'E Note 44 / 11050

3838-6015-R0-00A

TRW NOTE NO. 66 FMT - 223

PROJECT APOLLO
TASK MSC/TRW A-48

MATHEMATICAL MODEL OF NONDESTRUCT DOPPLER MEASUREMENTS

25 MAY 1966

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 66 FMT - 223

PROJECT APOLLO
TASK MSC/TRW A-48

MATHEMATICAL MODEL OF NONDESTRUCT DOPPLER MEASUREMENTS

25 MAY 1966

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TRW SYSTEMS

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-11

SUMMARY OF PHASE 1 AND PHASE 2

NAS 9-4810

22 OCTOBER 1965

TRW SYSTEMS

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3842-H002-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-49

LUNAR SATELLITE ANALYTIC EPHEMERIS GENERATOR (LSAEG)

NAS 9-4810

22 DECEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-31

3842-H003-R0-00A

TRW NOTE NO. 66-FMT-420

PROJECT APOLLO
TASK MSC/TRW A-49

GENERALIZED LUNAR SATELLITE ANALYTIC EPHEMERIS GENERATOR (GLSAEG)

15 JUNE 1966

ABRIDGEMENT

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TRW SYSTEMS

NARA SW Box E209H-31

TRW NOTE NO. 66-FMT-420

PROJECT APOLLO
TASK MSC/TRW A-49

GENERALIZED LUNAR SATELLITE ANALYTIC EPHEMERIS GENERATOR (GLSAEG)

15 JUNE 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-31

TRW NOTE NO. FMT-423

PROJECT APOLLO
TASK MSC/TRW A-49

GENERALIZED LUNAR SATELLITE ANALYTIC EPHEMERIS GENERATOR (GLSAEG) COMPUTER PROGRAM DESCRIPTION

15 JUNE 1966

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TRW SYSTEMS

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TRW NOTE NO. 66 FMT-204

PROJECT APOLLO
TASK MSC/TRW A-67

TECHNIQUES FOR OBTAINING EARTH ORBIT DEORBIT MANEUVER INFORMATION

18 MARCH 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-31

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3852-6001-RO-000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-33

GROUND MONITORING PROGRAM FOR LEM ASCENT PHASE

NAS 9-4810

30 NOVEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-31

3852-6002-R0-00A

TRW NOTE NO. 66 FMT-222

PROJECT APOLLO
TASK MSC/TRW A-33

FINAL REPORT ON GROUND MONITORING OF THE LEM ASCENT PHASE

27 MAY 1966

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

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3852-6002-R0-000

TRW NOTE NO. 66 FMT-222

PROJECT APOLLO
TASK MSC/TRW A-33

FINAL REPORT ON GROUND MONITORING OF THE LEM ASCENT PHASE

27 MAY 1966

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TRW SYSTEMS

NARA SW Box E209H-31

Cat

3858-6002-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-2

INTEGRATING MONTE CARLO PROGRAM FOR LEM ASCENT TO RENDEZVOUS

NAS 9-4810

28 SEPTEMBER 1965

TRW SYSTEMS

NARA SW Box E209H-31

3858-6005-R0-00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-2

E GUIDANCE EQUATIONS FOR LEM ASCENT

7 JANUARY 1966

ABRIDGEMENT

Prepared for
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Contract NAS 9-4810
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TRW SYSTEMS

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3858-6005-R0-000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-2

E GUIDANCE EQUATIONS FOR LEM ASCENT

NAS 9-4810

7 JANUARY 1966

TRW SYSTEMS

NARA SW Box E209H-31

3858-6006-R0-00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-2

MONTE CARLO SIMULATION RESULTS FOR LEM ASCENT PHASE

7 JANUARY 1966

ABRIDGEMENT

Prepared for
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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-2

MONTE CARLO SIMULATION RESULTS FOR LEM ASCENT PHASE

NAS 9-4810

7 JANUARY 1966

TRW SYSTEMS

NARA SW Box E209H-31

3842-H002-RU A01

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-49

LUNAR SATELLITE ANALYTIC EPHEMERIS GENERATOR (LSAEG)

22 DECEMBER 1965

ABRIDGEMENT

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-31

TRW NOTE NO. 66 FMT-228

PROJECT APOLLO
TASK MSC/TRW A-3

STATUS REPORT OF APOLLO SEPARATION AND RECONTACT ANALYSIS

10 JUNE 1966

ABRIDGEMENT

Prepared for

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NARA SW Box E209H-32

TRW NOTE NO. 66 FMT-228

PROJECT APOLLO
TASK MSC/TRW A-3

STATUS REPORT OF APOLLO SEPARATION AND RECONTACT ANALYSIS

10 JUNE 1966

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TRW SYSTEMS

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TRW NOTE NO. 66-FMT-428

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE TEST PLAN FOR THE AS-204 MISSION AGC PROGRAM

15 JULY 1966

Prepared for
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3888-6002-R0-000

TRW NOTE NO. 66 FMT-415

PROJECT APOLLO
TASK MSC/TRW A-97

RECOMMENDED AGC SOFTWARE VALIDATION SIMULATION INPUT/OUTPUT CAPABILITIES AND USER SYSTEM

13 MAY 1966

Prepared for
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AS-206A PRELIMINARY ABORT AND ALTERNATE MISSION STUDIES

NAS 9-4810

22 OCTOBER 1965

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract NAS 9-4810
Apollo MTCP

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3902-H002-RC000
Copy 58 of 229 copies
Total pages: 128

AS-501 SPACECRAFT
REFERENCE TRAJECTORY (U)

1 NOVEMBER 1965

VOLUME I
TRAJECTORY DESCRIPTION

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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3902-H005-RU000

AS-502 PRELIMINARY ABORT AND ALTERNATE MISSION PLAN

1 JANUARY 1966

Prepared for

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Contract NAS 9-4810

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RKP
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3902-H006-RC-000
Total Pages:300

APOLLO MISSION AS-207A PRELIMINARY SPACECRAFT REFERENCE TRAJECTORY (U)

24 JANUARY 1966

VOLUME I
TRAJECTORY DESCRIPTION

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract NAS 9-4810
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3902-H012-R0-000

TRW NOTE NO. 66-FMT-402

PROJECT APOLLO

APOLLO MISSION AS-206A
SPACECRAFT REFERENCE TRAJECTORY

28 FEBRUARY 1966

VOLUME I
TRAJECTORY DESCRIPTION

Prepared for
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14176
1090

3869-6004-R0-00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-3

SUMMARY REPORT OF APOLLO SEPARATION AND RECONTACT ANALYSIS

31 DECEMBER 1965

ABRIDGEMENT

Prepared for
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Contract NAS 9-4810
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3902-H015-R0-000

TRW NOTE NO. 66-FMT-412

PROJECT APOLLO

APOLLO MISSION AS-207/208A PRELIMINARY SPACECRAFT REFERENCE TRAJECTORY

30 APRIL 1966

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3902-H017-R0-000

TRW NOTE NO. 66-FMT-418

PROJECT APOLLO

APOLLO MISSION AS-207/208B OR AS-206/207 PRELIMINARY MISSION PROFILE

15 JUNE 1966

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RKP

3902-H018-R0-000

TRW NOTE NO. 66-FMT-425

PROJECT APOLLO

APOLLO MISSION AS-503D
PRELIMINARY MISSION PROFILE

1 JULY 1966

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3908-6004-RU-00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-4

APOLLO MISSION AS-201 RANGE SAFETY HAZARD STUDY

14 DECEMBER 1965

ABRIDGEMENT

Prepared for
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Apollo MTCP

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3908-6007-RO-00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-4

APOLLO RANGE SAFETY MISSION AS-202 SERVICE MODULE REENTRY BREAKUP

31 JANUARY 1966

ABRIDGEMENT

Prepared for
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3908-6014-T0-00A

TRW NOTE NO. 66 FMT-240

PROJECT APOLLO
TASK MSC/TRW A-4

APOLLO MISSION AS-202 RANGE SAFETY HAZARD STUDY

29 JULY 1966

ABRIDGEMENT

Prepared for
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3909-6001-RU00A

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-40

APOLLO SPACECRAFT PROPULSION MODELS FOR GE MASS PROGRAM

15 OCTOBER 1965

ABRIDGEMENT

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract NAS 9-4810
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TRW SYSTEMS

NARA SW Box E209H-33

TRW NOTE NO. 66 FMT-203

PROJECT APOLLO
TASK MSC/TRW A-57

AS-206A PRELIMINARY DISPERSION ANALYSIS

18 MARCH 1966

Prepared for
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T-16

3912-6001-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-50

TECHNICAL PLAN FOR APOLLO POSTFLIGHT TRAJECTORY ANALYSIS TASK

NAS 9-4810

16 SEPTEMBER 1965

*66-13148

TRW SYSTEMS

NARA SW Box E209H-33

TRW NOTE NO. 66 FMT-211

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO AS-201 TRAJECTORY RECONSTRUCTION

28 MARCH 1966

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 66 FMT-211

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO AS-201 TRAJECTORY RECONSTRUCTION

28 MARCH 1966

Prepared for
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TRW NOTE NO. 66 FMT-209

PROJECT APOLLO
TASK MSC/TRW A-86

PARAMETRIC STUDIES OF ENTRY TARGETING CRITERIA FOR MISSION AS-204

1 APRIL 1966

Prepared for
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3902-H014-R0-000

TRW NOTE NO. 66-FMT-402

PROJECT APOLLO

APOLLO MISSION AS-206A
SPACECRAFT REFERENCE TRAJECTORY

26 APRIL 1966

VOLUME III
RADAR SIGHTING AND SPACECRAFT
LOOK ANGLE DATA

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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3931-6001-RU000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-62

EVALUATION OF A MINIMUM ORBITAL ALTITUDE FOR APOLLO SPACECRAFT

NAS 9-4810

29 OCTOBER 1965

TRW SYSTEMS

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3931-6002-R0000

PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-31

APPLICATION OF HYBRID COMPUTERS TO APOLLO MISSION PLANNING TASKS

30 NOVEMBER 1965

ABRIDGEMENT

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Contract NAS 9-4810
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PROGRAM TECHNICAL REPORT
TASK MSC/TRW A-31

APPLICATION OF HYBRID COMPUTERS TO APOLLO MISSION PLANNING TASKS

NAS 9-4810 30 NOVEMBER 1965

Prepared for
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Contract NAS 9-4810
Apollo MTCP

TRW SYSTEMS

NARA SW Box E209H-34

TRW NOTE NO. 66 FMT-206

PROJECT APOLLO
TASK MSC/TRW A-62

EVALUATION OF A MINIMUM ORBITAL ALTITUDE FOR APOLLO SPACECRAFT — AMENDMENT 1

4 MARCH 1966

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 66 FMT-206

PROJECT APOLLO
TASK MSC/TRW A-62

EVALUATION OF A MINIMUM ORBITAL ALTITUDE FOR APOLLO SPACECRAFT — AMENDMENT 1

4 MARCH 1966

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FEB 23 1965

4174-6001-RU000

INTERIM TECHNICAL REPORT

ORBITAL DEBRIS REENTRY HAZARDS STUDY

CONTRACT NAS 9-2990

18 DECEMBER 1964

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4174-6002-RU000

INTERIM TECHNICAL REPORT

ORBITAL DEBRIS REENTRY HAZARDS STUDY

CONTRACT NAS 9-2990

31 AUGUST 1965

*69-25516

RM-86

Prepared for
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TRW SYSTEMS

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BHW PNM

4160-6046-RU000

PHASE II

VELOCITY CHANGE UNCERTAINTY PROCESSOR

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Under Contract NAS 9-2938

March 20, 1965

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GEMINI RENDEZVOUS ERROR ANALYSIS STUDY
STUDY NUMBER 3

EFFECTS OF MANEUVER EXECUTION DELAYS UPON RENDEZVOUS POSITION

17 May 1965

Prepared for

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Manned Spacecraft Center

Contract No. NAS 9-2938

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4160-6054-TU000
NAS9-2938
Total Pages - 49

PROGRAM PLAN AND DATA REQUIREMENTS FOR ORBIT AND RE-ENTRY ANALYSIS TASK TO BE PERFORMED BY TRW/STL IN SUPPORT OF GEMINI PROGRAM

By

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25 May 1965

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4160-6087-RU000

BI-MONTHLY PROGRESS REPORT
MISSION TRAJECTORY CONTROL PROGRAM
PROJECT GEMINI
(PHASES I AND Ia)

1 AUGUST 1965

PREPARED FOR THE NATIONAL
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Under Contract No. NAS9-2938

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FINAL TECHNICAL REPORT

• GEMINI MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-2938

1 OCTOBER 1965

TRW SYSTEMS

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3931-H001-R0-000

TRW NOTE NO. 66 FMT-405

PROJECT APOLLO
TASK MSC/TRW A-88

APOLLO RE-ENTRY STUDY PLANNING REPORT

Prepared by
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Mission Trajectory Control Program

15 MARCH 1966

Prepared for
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TRW SYSTEMS

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Type II

BIMONTHLY PROGRESS REPORT NO. 4
BENCH TEST AND MAINTENANCE EQUIPMENT
LEM ABORT GUIDANCE SECTION

Prepared for
Grumman Aircraft Engineering Corporation
under
PO 3-50021-c

10 May 1966

TRW No. 4618-6009-T0000

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8411-6001-RU000

STUDY OF LUNAR LANDING SENSOR PERFORMANCE INTERIM REPORT NO. 2

NAS8-5205 31 October 1963

Prepared for

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RECD GAEC

JAN 2 4 1964

DATA MGMT

SPECIAL REPORT
2:1 DIFFUSER–EJECTOR SYSTEM

GAEC Para. 5.9

STL No. 8438-6050-SU000 3 January 1964

Prepared for
Grumman Aircraft Engineering Corporation
Under Contract No. GPO2-18843-C

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G A E C Retrieval Code

Contract NAS 9-1100
Exhibit E TYPE II
Paragraph 11.2
Line Item
Primary No.

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TECHNICAL ASSISTANCE IN SUPPORT OF

PROJECT GEMINI

8858-6025-RU-000

1 MAY 1964

VOLUME I
FINAL REPORT

TRW SPACE TECHNOLOGY LABORATORIES
THOMPSON RAMO WOOLDRIDGE INC.

NARA SW Box E209H-35

AT.

9824-6001-RU-000

STL ON-LINE COMPUTER

Volume I — General Description

B. D. Fried

DECEMBER 28, 1964

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PHYSICAL RESEARCH DIVISION

TRW SPACE TECHNOLOGY LABORATORIES

THOMPSON RAMO WOOLDRIDGE INC.

NARA SW Box E209H-35

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-49

USER'S MANUAL FOR LUNAR SATELLITE ANALYTIC EMPHEMERIS GENERATOR (LSAEG) COMPUTER PROGRAM

28 JANUARY 1966

ABRIDGEMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

Contract NAS 9-4810

Apollo MTCP

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9842-6001-R0-000

PROGRAM TECHNICAL REPORT

TASK MSC/TRW A-49

USER'S MANUAL FOR LUNAR SATELLITE ANALYTIC EMPHEMERIS GENERATOR (LSAEG) COMPUTER PROGRAM

NAS 9-4810

28 JANUARY 1966

TRW SYSTEMS

NARA SW Box E209H-35

Task 15

THE EQUATIONS OF MOTION FOR A HYBRID COMPUTER SIMULATION OF THE GENERAL SEPARATION PROBLEM

By

Roger H. Hoh

9881.3-278

16 August 1965

2-7-26

TRW SYSTEMS

NARA SW Box E209H-35

APOLLO BLOCK II THRUST VECTOR CONTROL SYSTEM FEASIBILITY ANALYSES

INTERIM REPORT

4181-6001-MU000 1 October 1964

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Contract No. NAS9-2938

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LM DESCENT ENGINE

PROGRESS AND STATUS REPORTS

MONTHLY PROGRESS REPORT

DATA

DEC 26 1967

CONTROL

GAEC Para. 8.1

01827-6126-T000 10 December 1967

Prepared for
Grumman Aircraft Engineering Corporation
Under Contract P.O. 2-18843-c

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TYPE II

LM DESCENT ENGINE
PROGRESS AND STATUS REPORTS
MONTHLY PROGRESS REPORT

GAEC Para. 8.1

01827-6129-T000 10 January 1968

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[illegible] 1 [illegible]68

DATA [illegible]NTROL

LM DESCENT ENGINE
PROGRESS AND STATUS REPORTS
MONTHLY PROGRESS REPORT

GAEC Para. 8.1

01827-6151-T000 10 February 1968

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15 May 1969

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TYPE II

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RECEIVED
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GAEC Para. 8.1

01827-6114-T000 10 September 1967

Prepared for
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Under Contract P.O. 2-18843-c

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TRW SYSTEMS GROUP

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TRW NOTE NO. 68-FMT-653

PROJECT APOLLO
TASK MSC/TRW A-116

TAPE STORAGE COMPUTER PROGRAM RECTANGULARIZED COUNTRY INPUT DATA (MATAP)

17 MAY 1968

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TRW NOTE NO. 66-FMT-429

PROJECT GEMINI
TASK MSC/TRW G-18

ORBITAL AND RENDEZVOUS REPORT FOR GEMINI 11

NAS 9-4810 3 AUGUST 1966

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TRW SYSTEMS

NARA SW Box E209H-37

05952-H003-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-12

LM ATTITUDE CONTROL VALIDATION
FINAL REPORT

NAS 9-4810

10 AUGUST 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-37

TRW NOTE NO. 68-FMT-661

PROJECT APOLLO
TASK MSC/TRW A-116

POPULATION PROJECTION COMPUTER PROGRAM

19 JUNE 1968

Prepared for
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05952-H006-T0-00

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 AUGUST 1966

*67-15994

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NARA SW Box E209H-37

05952-H007-T0-00

BIMONTHLY PROGRESS REPORT

GEMINI MISSION TRAJECTORY CONTROL PROGRAM

15 AUGUST 1966

Prepared for
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BIMONTHLY PROGRESS REPORT

APOLLO APPLICATIONS MISSION
TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 AUGUST 1966

TRW SYSTEMS

NARA SW Box E209H-37

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

APSO TASK 34A

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NAS 9-4810

1 AUGUST 1966

TRW SYSTEMS

NARA SW Box E209H-37

05952-H010-T0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

30 JULY 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-37

TRW NOTE NO 66-FMT-431

PROJECT APOLLO
TASK MSC/TRW AA-1

COMPILATION OF TASK DESCRIPTIONS TO AUGMENT THE AAP MISSION DESIGN AND ANALYSIS PLAN

AUGUST 15, 1966

Prepared for
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TRW SYSTEMS

DOCUMENT NO. 3
SC LAUNCH ABORT ANALYSIS
DOCUMENT NO. 4
LV GUIDANCE REQUIREMENTS
DOCUMENT NO. 6
SC TRAJECTORY ANALYSIS
DOCUMENT NO. 7
PAAMS
DOCUMENT NO. 8
SC OPERATIONAL G&N REQUIREMENTS

NARA SW Box E209H-37

TRW NOTE NO. 66-FMT-432

PROJECT APOLLO
TASK MSC/TRW A-98

REAL-TIME PROGRAM SUPPORT AND AGC VERIFICATION

23 AUGUST 1966

Prepared for
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TRW SYSTEMS

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PROJECT TECHNICAL REPORT
TASK ASPO 20

APOLLO MISSION 501 GUIDED ENTRY FOOTPRINT AS A FUNCTION OF AERODYNAMIC LIFT-TO-DRAG RATIO

NAS 9-4810

15 AUGUST 1966

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05952-H001-RU-000

APOLLO SATURN MISSION 204A IMPLEMENTATION REQUIREMENTS OF SPACECRAFT MISSION OBJECTIVES

NAS 9-4810

1 AUGUST 1966

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TRW SYSTEMS

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NARA SW Box E209H-37

TRW NOTE NO. 66-FMT-434

PROJECT APOLLO
TASK MSC/TRW A-98

REAL-TIME PROGRAM SUPPORT AND AGC VERIFICATION OF THE AS-202 REENTRY GUIDANCE EQUATIONS

6 SEPTEMBER 1966

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TRW SYSTEMS

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TRW NOTE NO. 66-FMT-436

PROJECT APOLLO
TASK MSC/TRW A-92

APOLLO MISSION AS-202
REENTRY DISPERSION ANALYSIS

12 SEPTEMBER 1966

VOLUME II

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TRW SYSTEMS

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05952-H023-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO - 34 A

LM LANDING RADAR AIRCRAFT FLIGHT TEST PLAN

NAS 9-4810

7 SEPTEMBER 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-38

05952-H024-R0-00

APOLLO SPACECRAFT SYSTEM ANALYSIS PROGRAM

TECHNICAL REPORT

ASPO TASK 9B

APOLLO COMMUNICATIONS SYSTEM ANALYSIS

Prepared for

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NAS 9-4810

15 September 1966

TRW SYSTEMS

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34A

RADAR PERFORMANCE ASSESSMENT

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NAS 9-4810

1 SEPTEMBER 1966

TRW SYSTEMS

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05952-H026-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-15B

CRITICAL PARAMETERS STATUS SUMMARY

NAS 9-4810

12 SEPTEMBER 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-38

05952-H027-R0-00

APOLLO SPACECRAFT SYSTEM ANALYSIS PROGRAM

TECHNICAL REPORT

ASPO TASK 9B

APOLLO COMMUNICATIONS SYSTEM ANALYSIS

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NAS 9-4810

16 September 1966

TRW SYSTEMS

NARA SW Box E209H-38

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05952-H028-T0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT

SYSTEMS ANALYSIS PROGRAM

30 AUGUST 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

TRW SYSTEMS

NARA SW Box E209H-38

File

05952-H029-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-5A

BRIEFING CHARTS

RENDEZVOUS STUDY

10 SEPTEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS
HOUSTON OPERATIONS

NARA SW Box E209H-38

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05952-H030-R0-00

TRW NOTE NO. 66-FMT-437

PROJECT APOLLO

APOLLO MISSION AS-207/208A
SPACECRAFT REFERENCE TRAJECTORY

19 SEPTEMBER 1966

VOLUME I
TRAJECTORY DESCRIPTION

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TRW SYSTEMS

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05952-H032-R0-00

TRW NOTE NO. 66-FMT-464

PROJECT APOLLO

TASK MSC/TRW A-45

APOLLO MISSION AS-207/208A SPACECRAFT REFERENCE TRAJECTORY

VOLUME III
RADAR SIGHTING AND SPACECRAFT LOOK ANGLE DATA

1 DECEMBER 1966

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PROJECT TECHNICAL REPORT

MSC/TRW TASK A-97

SCHEDULE FOR INDEPENDENT ONBOARD FLIGHT SOFTWARE VALIDATION

Prepared for:

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NAS 9-4810

22 September 1966

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TRW NOTE NO. 67-FMT-435

PROJECT APOLLO

TASKS MSC/TRW A-115, 120

APOLLO REENTRY SIMULATION PROGRAM
USERS MANUAL ADDENDUM

13 MARCH 1967

Prepared for
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TRW SYSTEMS

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PROJECT TECHNICAL REPORT

TASK ASPO - 34 A

LANDING RADAR ANTENNA BORESIGHT TEST PLAN

NAS 9 - 4810 31 March 1967

R E V I S I O N 1

Prepared for

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05952-H035-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-34A

RENDEZVOUS RADAR FLIGHT TEST PLAN

NAS 9-4810

15 SEPTEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-39

05952-H036-R0-00

PROJECT TECHNICAL REPORT
MSC - TRW TASK ASPO 22A

MONTE CARLO ANALYSIS OF SUCCESS PROBABILITY OF LM SOFT LUNAR LANDING

NAS 9-4810

26 SEPTEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-39

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05952-H037-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO-37

ANALYSIS REQUIREMENTS FOR LM DESCENT STRATEGY

NAS 9-4810

21 SEPTEMBER 1966

Prepared for
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TRW SYSTEMS

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05952-H038-R0-00

TRW NOTE NO. 66-FMT-438

PROJECT APOLLO APPLICATIONS
TASK MSC/TRW AA-1

FINAL REPORT - SUBTASK AA-1.4

NAS 9-4810

30 SEPTEMBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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05952-H039-R0-00

APOLLO COMMUNICATION SYSTEMS
ASPO Task 9B
TECHNICAL REPORT

ANALYSIS TO SUPPORT THE DETAILED SYSTEM TEST OF THE S-BAND PM DOWNLINK COMMUNICATION SYSTEM

---

30 SEPTEMBER 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-39

05952-H045-R0-0-A

TRW NOTE NO. 66-FMT-444

PROJECT APOLLO
TASK MSC/TRW A-104

LM DISPLAY ANALYSIS - SUMMARY REPORT

ABRIDGEMENT

12 OCTOBER 1966

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TRW SYSTEMS

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05952-H047-T0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 OCTOBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

TRW SYSTEMS

NARA SW Box E209H-39

NOV 16 1966

05952-H049-T0-00

BIMONTHLY PROGRESS REPORT

GEMINI MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 OCTOBER 1966

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05952-H050-T0-00

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 OCTOBER 1966

TRW SYSTEMS

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05952-H051-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-43

APOLLO MISSION AS-204
COMPATIBILITY ANALYSIS

NAS 9-4810

14 OCTOBER 1966

Prepared for
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NARA SW Box E209H-39

SUPERSEDED
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PROJECT APOLLO

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION APOLLO SATURN 204A (CSM 012)/205 (CSM 014) REVISION 2

17 OCTOBER 1966

SAVE SUPERSEDED FOR CONFIG. INFO.

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract No. NAS 9-4810
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PROJECT APOLLO

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION APOLLO SATURN 204A (CSM 012) REVISION 3

5 DECEMBER 1966

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05952-H032-R0-00

H034

PROJECT TECHNICAL REPORT

TASK ASPO - 34 A

LANDING RADAR ANTENNA BORESIGHT TEST PLAN

NAS 9-4810

26 SEPTEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-39

Reclassified to [illegible]
by authority of [illegible]
this date [illegible]

APOLLO MISSION DATA SPECIFICATION D

APOLLO SATURN 205 (U)

JUNE 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

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APOLLO MISSION DATA SPECIFICATION D

APOLLO SATURN 501 (U)

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by authority of D, J, & Final
Dist SCB, Hdtrs
this date 6/16/71 JM

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HOUSTON, TEXAS

NAS 9-4810

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by authority of Lt. J.E. Smart
VAST-SCD, 7/1/70
this date 6/17/71 Jsr

APOLLO MISSION DATA SPECIFICATION C
APOLLO-SATURN 206A (U)

5 November 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

Contract No. NAS 9-4810

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2131-6003-TC-000
Total Pages: 44

APOLLO MISSION DATA SPECIFICATION A

APOLLO SATURN 504 AND SUBSEQUENT MISSIONS (U)

30 December 1965

Reclassified to Unclass
by authority of Ltr, J. E. Smart
NASA-SCB, 7/1/70
this date 6/17/71

Prepared for
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Contract No. NAS 9-4810

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2131-6004-T8-000
Total Pages: 65

APOLLO MISSION DATA SPECIFICATION
APOLLO SATURN 502 (PACKAGE C) (U)

21 January 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

Contract No. NAS 9-4810

Reclassified to Unclass
by authority of Ltr, J.E. Grant
NASA-SCB, 2/1/70
this date 6/17/71 Jm

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2131-6005-T8-000
Total Pages: 51

APOLLO MISSION DATA SPECIFICATION

APOLLO SATURN 503

(PACKAGE B) (U)

Reclassified to Unclass
by authority of Ltr, J. E. Smart
NASA-SCB, 7/1/70
this date 6/17/71 Jm

Prepared for

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Contract No. NAS 9-4810

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PROJECT APOLLO
TASK ASPO 31

APOLLO MISSION A-004
LITTLE JOE II
INVESTIGATION OF LITTLE JOE II PRE-FLIGHT ATTITUDE CONTROL SYSTEM ANOMALIES

NAS 9-4810

9 February 1966

Prepared by Donald H. Kienle

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HOUSTON, TEXAS

TRW SYSTEMS

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TRW SYSTEMS

MISSION REQUIREMENTS

FOR

APOLLO SPACECRAFT AND SATURN LAUNCH VEHICLE DEVELOPMENT MISSION

APOLLO SATURN 204B

3 SEPTEMBER 1965

Prepared for

Manned Spacecraft Center

National Aeronautics and Space Administration

under

Contract Number NAS 9-4810

MSC/TRW Task ASPO-13

NARA SW Box E209H-3

DEC 8 - 1965

2132-H001-RU-R01

TRW SYSTEMS

MISSION REQUIREMENTS

FOR

APOLLO SPACECRAFT AND SATURN LAUNCH VEHICLE DEVELOPMENT MISSION

APOLLO SATURN 204B

REVISION 1

1 DECEMBER 1965

Prepared for

Manned Spacecraft Center

National Aeronautics and Space Administration

under

Contract Number NAS 9-4810

MSC/TRW Task ASPO-13

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PM 3/6/7
3/28/66

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PROJECT APOLLO
TASK MSC/TRW ASPO-13

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION APOLLO SATURN 503A (U) REVISION 1

NAS 9-4810

18 FEBRUARY 1966

Reclassified to Unclass
by authority of Lt. J.E. Smart
NASA-SCB 4/1/70
this date

Prepared for
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2132-H002-RU-000

TRW SYSTEMS

MISSION REQUIREMENTS

FOR

APOLLO SPACECRAFT DEVELOPMENT

MISSION AS 503A

8 October 1965

Prepared for

Manned Spacecraft Center

National Aeronautics and Space Administration

under

Contract Number NAS 9-4810

MSC/TRW Task ASPO-13

NARA SW Box E209H-3

PP7/M.E.Dell

2132-H004-RU-000

TRW SYSTEMS

MISSION REQUIREMENTS

FOR

APOLLO SPACECRAFT DEVELOPMENT

MISSION AS-206A

1 December 1965

Prepared for

Manned Spacecraft Center

National Aeronautics and Space Administration

under

Contract Number NAS 9-4810

MSC/TRW Task ASPO-13

NARA SW Box E209H-3

2132-H004-RU-001

PROJECT APOLLO

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION AS-206A REVISION I

8 FEBRUARY 1966

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Prepared by

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW ASPO-13

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION AS-206A REVISION 2

NAS 9-4810

16 AUGUST 1966

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PROJECT APOLLO
TASK MSC/TRW ASPO-13

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION APOLLO SATURN 504A (U) REVISION 1

15 APRIL 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Reclassified to Unclass
by authority of Lt. J.E. Smart
NASA-SCB, 7/1/70
this date 6/16/71 Jm

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[redacted]-000

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MISSION REQUIREMENTS FOR APOLLO SC/LEM
MISSION AS-[redacted]

NAS 9-4810

[redacted] February 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
MSC/TRW Task ASPO-[redacted]

Reclassified to Unclassified
by authority of Dr. J. E. Smart
NASA S.C.G. 7/1/76
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PROJECT APOLLO

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSIONS AS-206/207 AND AS-207/208B (U)

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NASA-SCB, 7/1/70
this date 6/16/71 Jm

1 APRIL 1966

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2132-H010-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO-13

CSM-008 THERMAL VACUUM TEST
TEST REQUIREMENTS ANALYSES REPORT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

20 March 1966

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PROGRAM TECHNICAL REPORT
TASK MSC/TRW ASPO-13

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION AS-206

NAS 9-4810

28 OCTOBER 1966

REVISION 3

Prepared for
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2132-H003-RU-000

PROJECT APOLLO

MISSION REQUIREMENTS

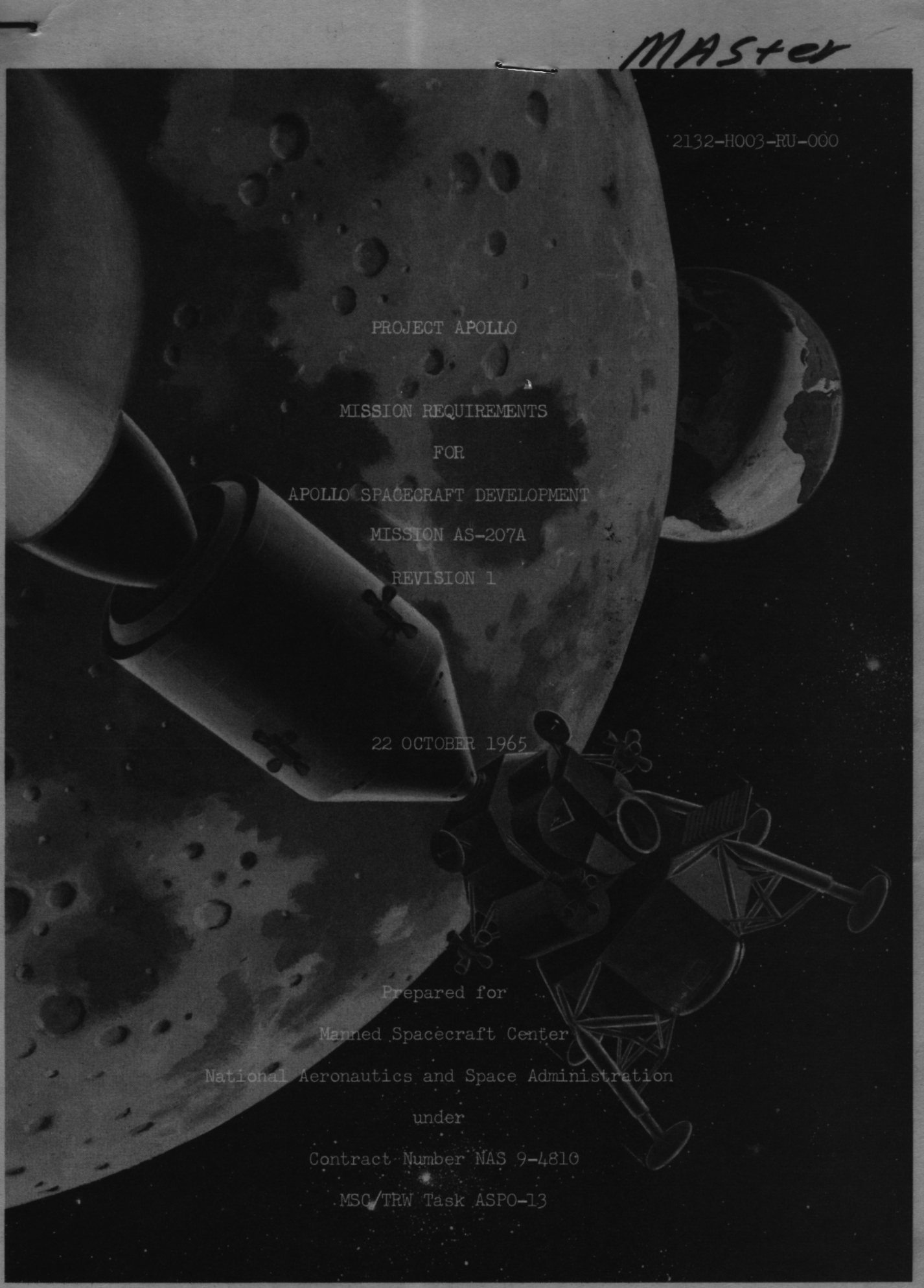
FOR

APOLLO SPACECRAFT DEVELOPMENT

MISSION AS-207A

REVISION 1

22 OCTOBER 1965



Prepared for

Manned Spacecraft Center

National Aeronautics and Space Administration

under

Contract Number NAS 9-4810

MSC/TRW Task ASPO-13

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APOLLO MISSION DATA SPECIFICATION C

APOLLO SATURN 503A (U)

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Contract No. NAS 9-4810

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05952-H054-R0-00

TRW NOTE NO. 66-FMT-446

PROJECT APOLLO
TASK MSC/TRW A-92

APOLLO MISSION AS-204
REENTRY DISPERSION ANALYSIS

26 OCTOBER 1966

VOLUME II

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

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05952-H055-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-5A

BRIEFING CHARTS AND NOTES
LM LANDING RADAR STUDY

NAS 9-4810

14 OCTOBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

TRW NOTE NO. 66-FMT- 448

PROJECT APOLLO
TASK MSC/TRW A-105

OPERATING INSTRUCTIONS AND CARD FORMATS FOR OBSIM AND NAVSIM (AS-207/208 VERSION)

20 OCTOBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NAS 9-4810

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05952-H057-R0-91

TRW NOTE NO. 66-FMT-468

PROJECT APOLLO
TASK MSC/TRW A-105

OPERATING INSTRUCTIONS AND CARD FORMATS FOR OBSIM AND NAVSIM (AS-207/208 VERSION)

REVISION 1

1 NOVEMBER 1966

Prepared for
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PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO-13C

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION APOLLO - SATURN 501/502

NAS 9-4810

26 OCTOBER 1966

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PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO - 13D

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSIONS APOLLO - SATURN 501 AND 502

NAS 9-4810

3 JANUARY 1967

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Prepared for
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TRW NOTE NO. 66-FMT-451

PROJECT APOLLO
TASK MSC/TRW A-34

DOPPLER THEORY FOR ORBIT DETERMINATION

27 OCTOBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NAS 9-4810

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Program

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05952-H062-R000

APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9B
TECHNICAL REPORT

ANALYSIS TO SUPPORT THE DETAILED SYSTEM TEST OF THE APOLLO CSM BLOCK II FM DOWNLINK COMMUNICATION SYSTEM

NAS 9-4810

28 October 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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TRW NOTE NO. 66-FMT-453

PROJECT APOLLO
TASK MSC/TRW A-92

APOLLO MISSION AS-501 ENTRY CORRIDOR AND BACKUP ENTRY MODE ANALYSIS ADDENDUM 1

1 MAY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS
NAS 9-4810

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R. K. Petersburg, Manager
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Program

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TRW NOTE NO. 66-FMT-450

PROJECT APOLLO
TASK MSC/TRW A-9

APOLLO REENTRY SIMULATION PROGRAM

VOLUME I

25 OCTOBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

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TRW SYSTEMS

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05952-H053-T0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

QUARTERLY PROGRESS REPORT

ASPO TASK 34A

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

NAS 9-4810

11 OCTOBER 1966

TRW Systems

Space Park Drive - Houston, Texas

NARA SW Box E209H-40

RLP for JMD

TRW NOTE NO. 66-FMT-454

PROJECT APOLLO
TASK MSC/TRW A-20

AS-501 SPACECRAFT OPERATIONAL TRAJECTORY

VOLUME I
TRAJECTORY DESCRIPTION

15 NOVEMBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NAS 9-4810

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R. K. Petersburg, Manager
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TRW NOTE NO. 66-FMT-456

PROJECT APOLLO
TASK MSC/TRW A-60.1

MOON REFERENCE ABORT PROGRAM (INTERIM VERSION)

28 NOVEMBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NAS 9-4810

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R. W. Johnson, Manager
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05952-H070-R0-00

TRW NOTE NO. 66-FMT-457

PROJECT APOLLO
TASK MSC/TRW A-100

APOLLO LUNAR LANDING MISSION MIDCOURSE MANEUVER PROCEDURES

11 NOVEMBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NAS9-4810

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05952-H071-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-38

AS-204 GUIDANCE NAVIGATION AND CONTROL SYSTEM FLIGHT TEST ANALYSIS PLAN

NAS 9-4810

7 DECEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NARA SW Box E209H-41

TRW NOTE NO. 66-FMT-458

PROJECT APOLLO
TASK MSC/TRW AA-4

MODIFIED MSC FORWARD ITERATOR

VOLUME II
ITERATOR

9 NOVEMBER 1966

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW NOTE NO. 66-FMT-450

PROJECT APOLLO
TASK MSC/TRW A-9

APOLLO REENTRY SIMULATION PROGRAM

VOLUME II

25 OCTOBER 1966

Prepared for
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05952-H075-R0-00
MSC IN 66-FM-139
VOLUME II

TRW NOTE NO. 66-FMT-461

PROJECT APOLLO
TASK MSC/TRW A-54

APOLLO MISSION AS-204
SPACECRAFT DISPERSION ANALYSIS

VOLUME II OF MSC
INTERNAL NOTE NO. 66-FM-139

17 NOVEMBER 1966

Prepared for
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TRW NOTE NO. 66-FMT-460

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE TEST PLAN FOR THE AS-501 MISSION AGC PROGRAM

8 NOVEMBER 1966

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05952-H077-T0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 NOVEMBER 1966

Prepared for
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05952-H078-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO-42

APOLLO MISSION SUPPORT AND POSTFLIGHT DATA PROCESSING REQUIREMENTS - MISSION AS-204

NAS 9-4810

4 NOVEMBER 1966

Prepared for
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05952-H079-T0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34A

NAS 9-4810

1 NOVEMBER 1966

RADAR PERFORMANCE ASSESSMENT

Prepared for

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05952-H080-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO - 34A

TEST PLANNING AND EVALUATION DOCUMENT
VOLUME I

NAS 9-4810

15 NOVEMBER 1966

Prepared for
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APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9B
TECHNICAL REPORT

ANALYSIS TO SUPPORT THE GROSS SYSTEM TEST OF THE LEM FM DOWNLINK COMMUNICATION SYSTEM

NAS 9-4810

18 NOVEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-42

05952-H082-R000

APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9B
TECHNICAL REPORT

ANALYSIS TO SUPPORT THE LEM GROSS SYSTEM TEST OF THE UPLINK S-BAND COMMUNICATIONS SYSTEM

15 NOVEMBER 1966

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Under

Contract No. NAS 9-4810

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TRW NOTE NO. 66-FMT-462

PROJECT APOLLO
TASK MSC/TRW A-98

REAL-TIME PROGRAM VERIFICATION OF THE AS-204 REENTRY GUIDANCE EQUATIONS

1 DECEMBER 1966

Prepared for
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05952-H084-R0-00

TRW NOTE NO. 66-FMT-463

PROJECT APOLLO
TASK MSC/TRW A-92

APOLLO MISSION AS-501 OPERATIONAL TRAJECTORY ENTRY ANALYSIS

15 DECEMBER 1966

Prepared for
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TRW NOTE NO. 66-FMT-465

PROJECT APOLLO
TASK MSC/TRW A-20

AS-501 SPACECRAFT OPERATIONAL TRAJECTORY

VOLUME II
TRAJECTORY LISTING AND SIMULATION INPUT DATA

15 NOVEMBER 1966

Prepared for
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TRW NOTE NO. 66-FMT-466

PROJECT APOLLO
TASK MSC/TRW A-113

APOLLO MISSION AS-207/208A PRELIMINARY ABORT AND ALTERNATE MISSION STUDY

22 NOVEMBER 1966

Prepared for
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TRW NOTE NO. 66-FMT-459

PROJECT APOLLO

TASK MSC/TRW AA-4

MODIFIED MSC FORWARD ITERATOR

VOLUME III
INPUT GUIDE

9 NOVEMBER 1966

Prepared for
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05952-H088-RO-00

PROGRAM TECHNICAL REPORT

Task ASPO 41

TRW SESL CHAMBER A

THERMAL ENVIRONMENT/008 SPACECRAFT COMPUTER PROGRAM

ADDENDUM 1

NAS 9-4810

18 November 1966

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05952-H090-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO - 37

HIGH VIEW ANGLE STUDY

NAS 9-4810

28 NOVEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-43_44

JAN 12 1967

05952-H094-T0-00

BIMONTHLY PROGRESS REPORT

GEMINI MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 DECEMBER 1966

TRW SYSTEMS

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TRW NOTE NO. 66-FMT-470

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE VALIDATION TEST RESULTS FOR MISSION AS-204A

13 DECEMBER 1966

Prepared for
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TRW SYSTEMS

APPENDIX A
INITIALIZATION

APPENDIX C
NOMINAL

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JAN 12 1967

05952-H095-T0-00

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 DECEMBER 1966

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05952-H096-T0-00

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APOLLO APPLICATIONS MISSION
TRAJECTORY CONTROL PROGRAM

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15 DECEMBER 1966

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05952-H097-T0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 DECEMBER 1966

Prepared for
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05952-H098-T0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34A

NAS 9-4810 1 DECEMBER 1966

RADAR PERFORMANCE ASSESSMENT

Prepared for

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05952-H102-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-43

APOLLO MISSION AS-501
CONSUMABLES ANALYSIS

NAS 9-4810

15 DECEMBER 1966

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-43_44

TRW NOTE NO. 66-FMT-472

PROJECT APOLLO
TASK MSC/TRW A-60.1

MOON REFERENCE ABORT PROGRAM TEST RESULTS

10 JANUARY 1967

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 66-FMT-473

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE TEST PLAN FOR THE AS-206 MISSION LGC PROGRAM

15 DECEMBER 1966

Prepared for
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TRW SYSTEMS

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05952-HT05-R0-0A

TRW NOTE NO. 66-FMT-474

PROJECT APOLLO
TASK MSC/TRW A-105

OBSIM AND NAVSIM DETAILED SUBROUTINE AND PROGRAM DESCRIPTION (AS-207/208 VERSION) BOOK 1, OBSIM AND BOOK 2, NAVSIM

ABRIDGEMENT

1 FEBRUARY 1967

Prepared for
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TRW NOTE NO. 66-FMT-474

PROJECT APOLLO
TASK MSC/TRW A-105

OBSIM AND NAVSIM DETAILED SUBROUTINE AND PROGRAM DESCRIPTION (AS-207/208 VERSION) BOOK 1, OBSIM

15 JANUARY 1967

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 66-FMT-475

PROJECT APOLLO
TASK MSC/TRW A-105

OBSIM AND NAVSIM DETAILED SUBROUTINE AND PROGRAM DESCRIPTION (AS-207/208 VERSION) BOOK 2, NAVSIM

30 JANUARY 1967

Prepared for
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TRW SYSTEMS

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APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9B
TECHNICAL REPORT

PRELIMINARY APOLLO COMMUNICATION COMPATIBILITY ANALYSIS MISSION AS-501 REVISED

Prepared for
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HOUSTON, TEXAS

Contract No. NAS 9-4810

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TRW SYSTEMS

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05952-H107-R0-00

APOLLO COMMUNICATION SYSTEMS
ASPO Task 9B
TECHNICAL REPORT

PRELIMINARY APOLLO COMMUNICATION COMPATIBILITY ANALYSIS MISSION AS-501

30 DECEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Under
Contract No. NAS 9-4810

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05952-H108-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-12

POSTFLIGHT HEAT SHIELD THERMAL ANALYSIS ON APOLLO MISSION AS-202

NAS 9-4810

30 NOVEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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TRW NOTE NO. 66-FMT-476

PROJECT APOLLO
TASK MSC/TRW A-20

AS-501 SPACECRAFT OPERATIONAL TRAJECTORY

VOLUME III
RADAR SIGHTING AND SPACECRAFT LOOK ANGLE DATA

9 JANUARY 1967

Prepared for
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05952-H110-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO - 37

PARAMETRIC SUMMARY OF LM DESCENT APPROACH PHASE TRAJECTORY STUDIES

NAS 9-4810

22 DECEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-43_44

TRW NOTE NO. 67-FMT-477

PROJECT APOLLO
TASK MSC/TRW A-54

TAPP IV PROGRAM DESCRIPTION

31 MARCH 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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05952-H113-R0-00

TRW NOTE NO. 66-FMT-478

PROJECT APOLLO

TASK MSC/TRW AA-6

MPAD FLIGHT ANALYSIS BRANCH REQUIREMENTS IDENTIFICATION FOR APOLLO APPLICATIONS PROGRAM

23 JANUARY 1967

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05952-H087-R000

APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9B
TECHNICAL REPORT

ANALYSIS TO SUPPORT THE LEM GROSS SYSTEM TEST OF THE PM DOWNLINK UNIFIED S-BAND COMMUNICATION SYSTEM

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23 NOVEMBER 1966

Prepared for

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Under
Contract No. NAS 9-4810

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NARA SW Box E209H-43_44

TRW NOTE NO. 66-FMT-480

PROJECT APOLLO
TASK MSC/TRW A-121

ANALYSIS OF TIMEKEEPING ERRORS FOR THE APOLLO MISSIONS

17 JANUARY 1967

Prepared for
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05952-H118-R0-00A

TRW NOTE NO. 66-FMT-481

PROJECT APOLLO
TASK MSC/TRW A-49

ANALYTIC ORBIT PREDICTION PROGRAM (AOPP) DESCRIPTION

15 JANUARY 1967

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 66-FMT-481

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TASK MSC/TRW A-49

ANALYTIC ORBIT PREDICTION PROGRAM (AOPP) DESCRIPTION

15 JANUARY 1967

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

QUARTERLY PROGRESS REPORT

ASPO TASK 34-A

NAS 9-4810 1 JANUARY 1967

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
ASPO TASK 34A
TECHNICAL REPORT
RADAR PERFORMANCE ASSESSMENT

EVALUATION OF LANDING RADAR SIGNAL TO NOISE RATIO

NAS 9-4810 1 APRIL 1967

Prepared for

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05952-H122-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO - 43

APOLLO MISSION AS-206
CONSUMABLES ANALYSIS

NAS 9-4810

13 JANUARY 1967

Prepared for
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05952-H123-R0-00

TRW NOTE NO. 66-FMT-482

PROJECT APOLLO

TASK MSC/TRW AA-7

MPAD/MAB ORBITAL MISSION DESIGN SECTION
AAP MISSION RESPONSIBILITIES AND FUNCTIONS

24 JANUARY 1967

Prepared by
Spaceflight Operations Department
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APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9B
TECHNICAL REPORT

ANALYSIS TO SUPPORT THE GROSS LM-MSFN-CSM COMBINED SYSTEM TEST OF THE UNIFIED S-BAND COMMUNICATION SYSTEM

25 JANUARY 1967

Prepared for
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Contract No. NAS 9-4810

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TRW SYSTEMS

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PA 2 Files

05952-H125-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO - 13D

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION APOLLO-SATURN 205/208A

NAS 9-4810

3 JANUARY 1967

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05952-H126-T0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 JANUARY 1967

Prepared for
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TRW NOTE NO. 66-FMT-479

PROJECT APOLLO
TASK MSC/TRW A-103.3

AS-204 TRAJECTORY VERIFICATION

16 JANUARY 1967

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TRW SYSTEMS

NARA SW Box E209H-45

TRW NOTE NO. 66-FMT-490

PROJECT APOLLO
TASK MSC/TRW A-34, A-108

AT-85 USERS GUIDE
(TASK A-34/A-108 VERSION)

1 FEBRUARY 1967

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-46

TRW NOTE NO. 67-FMT-490

PROJECT APOLLO
TASK MSC/TRW A-108

AT-85D USERS GUIDE (TASK A-108 VERSION)

14 NOVEMBER 1967

Prepared for
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05952-H130-R0-00

MSC INTERNAL NOTE 67-FM-5

PROJECT APOLLO
TASK MSC/TRW A-21

APOLLO MISSION AS-206 SPACECRAFT OPERATIONAL TRAJECTORY

10 FEBRUARY 1967

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 66-FMT-486

PROJECT APOLLO
MSC/TRW TASKS A-34 AND A-108

USBS FORMULATIONS FOR APOLLO POSTFLIGHT ANALYSIS

31 JANUARY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

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TRW NOTE NO. 67-FMT-487

PROJECT APOLLO
TASK MSC/TRW A-98

AMENDMENT TO AGC VERIFICATION OF THE AS-204 REENTRY GUIDANCE EQUATIONS

28 MARCH 1967

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-46

05952-H133-R0-00

PROJECT TECHNICAL REPORT

TASK MSC/TRW ASPO-51

LAUNCH MISSION RULES INPUTS FOR APOLLO SATURN DEVELOPMENT MISSION AS-204/LM-1

NAS 9-4810

23 JANUARY 1967

REV. C 10 MAY 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-46

05952-H135-R0-00

PROJECT TECHNICAL REPORT
TASK MSC/TRW ASPO-13D

LAUNCH MISSION RULES INPUTS FOR APOLLO SATURN DEVELOPMENT MISSION AS-501

NAS 9-4810

26 JANUARY 1967

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-46

[redacted]

05952-H138-R8-00

PROJECT TECHNICAL REPORT
TASK MSC/TRW ASPO 19A-1

PRELIMINARY PERFORMANCE CHARACTERIZATION FOR THE SPS BLOCK II ENGINE

NAS 9-4810

1 FEBRUARY 1967

2.4.19

Prepared for
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05952-H139-R0-0

APOLLO BLOCK I
TASK MSC/TRW ASPO-19B

AS-204
SPACECRAFT 012
PROPULSION FLIGHT EVALUATION PLAN

NAS 9-4810

31 JANUARY 196

TRW SYSTEMS

NARA SW Box E209H-46

TRW NOTE NO. 66-FMT-489

PROJECT APOLLO
TASK MSC/TRW A-126

INTERIM REPORT
LM DESCENT ABORT ANALYSIS FOR DISPLAY

27 JANUARY 1967

Prepared for
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NAS 9-4810

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TRW SYSTEMS

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TRW NOTE NO. 67-FMT-498

PROJECT APOLLO
TASK MSC/TRW A-129

APOLLO SPACECRAFT PROPULSION MODELS

15 MARCH 1967

Prepared for
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TRW SYSTEMS

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OPTIONAL FORM NO. 10
MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

NASA - Manned Spacecraft Center
Mission Planning & Analysis Division

05952-H142-RO-01

TO :See attached list

DATE: 6 JUL 1967
File No. 67-FM13-242

FROM :FM13/Apollo Trajectory Support Office

SUBJECT: Revision to the Spacecraft Operational Abort and Alternate Mission Plan for AS-501

The attached document is a revision to the Spacecraft Operational Abort and Alternate Mission Plan for AS-501 (MSC Internal Note 66-FM-149), volume II. This revision takes into account the reduction in nominal entry range to 2000 m. mi. and utilizes a nominal L/D of 0.35. At the present time it is not planned to provide a formal revision to volume I. The necessary updates to volume I, such as the flight control limit lines, will be provided by memorandum.

All comments regarding this document, its contents or distribution should be directed to this office.

E. Dixon Murrah
E. Dixon Murrah

APPROVED BY:

John P. Mayer
Chief, Mission Planning
and Analysis Division

JPB JPB

FM13/E. D. Murrah:pc 7-5-67

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Leon H1/2047

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05952-H143-R0-00

Apollo 5

FEB 24 1967

PROJECT TECHNICAL REPORT
TASK MSC/TRW ASPO-13

MISSION REQUIREMENTS FOR APOLLO SPACECRAFT DEVELOPMENT MISSION AS-206

NAS 9-4810

7 FEBRUARY 1967

REVISION 4

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

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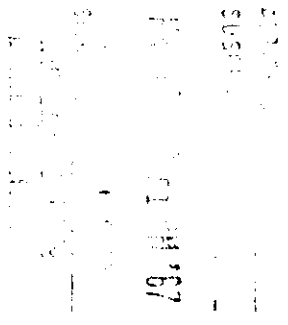
PROJECT TECHNICAL REPORT
TASK MSC/TRW ASPO-51

LAUNCH MISSION RULES INPUTS FOR APOLLO SATURN DEVELOPMENT MISSION AS-502/020

NAS 9-4810

REV. A 12 MAY 1967
Supersedes 15 February 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS



TRW SYSTEMS

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TRW NOTE NO. 66-FMT-491

PROJECT APOLLO
TASK MSC/TRW A-105

POLYNOMIAL APPROXIMATIONS FOR SHORT-ARC LUNAR EPHEMERIDES

15 FEBRUARY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34-A

NAS 9-4810 1 FEBRUARY 1967

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS
Space Park Drive - Houston

NARA SW Box E209H-46

TRW NOTE NO. 66-FMT-483

PROJECT APOLLO
TASK MSC/TRW A-49

ANALYTIC ORBIT PREDICTION

15 JANUARY 1967

Prepared for
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NAS 9-4810

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TRW SYSTEMS

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05952-H148-T0-00

BIMONTHLY PROGRESS REPORT

GEMINI MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 FEBRUARY 1967

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APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 FEBRUARY 1967

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H. S. Lean H1/2047

05952-H151-RO-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 FEBRUARY 1967

Prepared for
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MAY 5 1967

05952-H152-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO-13

MISSION REQUIREMENTS FOR FIRST APOLLO LUNAR LANDING MISSION REVISION 3

(564-r)

NAS 9-4810

11 APRIL 1967

Prepared for
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Action: _____
Info: _____
From: PA/K.S. Kleinknecht
Date: _____

TRW SYSTEMS

NARA SW Box E209H-47

TRW NOTE NO. 67-FMT-492

PROJECT APOLLO
TASK MSC/TRW A-54.1

TAPP-V PROGRAM DESCRIPTION

27 FEBRUARY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

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TRW NOTE NO. 67-FMT-493

PROJECT APOLLO
TASK MSC/TRW A-105

SIMULATIONS OF ONBOARD NAVIGATION AS-258 MISSION

28 FEBRUARY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NAS 9-4810

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TRW SYSTEMS

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PROJECT TECHNICAL REPORT
TASK ASPO-43

APOLLO MISSION AS-502
CONSUMABLES ANALYSIS

NAS 9-4810

1 MARCH 1967

Prepared for
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05952-H156-R0-00

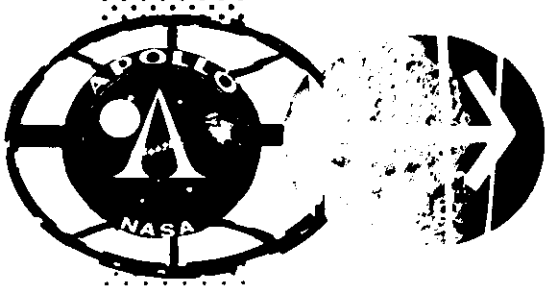
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-39

10 MARCH 1967

SPACECRAFT REFERENCE TRAJECTORY FOR AS-205/208B

By Mission Design Section
TRW Systems



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TABLES

ILLUSTRATIONS

APPENDIX

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TRW NOTE NO. 67-FMT-494

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE TEST PLAN FOR THE AS-205/208A MISSION LGC AND CMC PROGRAMS

ABRIDGEMENT

27 FEBRUARY 1967

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-47

TRW NOTE NO. 67-FMT-494

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE TEST PLAN FOR THE AS-205/208A MISSION LGC AND CMC PROGRAMS

27 FEBRUARY 1967

Prepared for
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05952-H159-R0-00

MSC INTERNAL NOTE 67-FM-5

PROJECT APOLLO
TASK MSC/TRW A-21

APOLLO MISSION AS-206 SPACECRAFT OPERATIONAL TRAJECTORY VOLUME III, MSFN COVERAGE DATA

1 MARCH 1967

Prepared for
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TRW SYSTEMS

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MAY 1962 EDITION
GSA FPMR (41 CFR) 101-11.6

UNITED STATES GOVERNMENT

Memorandum

TO : See attached list

DATE: 10 MAR 1967

File No. 67-FM13-85

FROM : FM13/Apollo Trajectory Support Office

SUBJECT: AAP 1/2 Preliminary Mission Profile

The attached document presents the Apollo Applications Mission A (AAP 1/2) Preliminary Mission Profile. This is the first of a series of four major trajectory design documents which will be published throughout the mission planning sequence. It was designed to satisfy the proposed mission requirements as recommended to the Apollo Applications Program Office by memorandum 66-FM14-126, "SAA-209/210 Mission Requirements," dated November 6, 1967.

All comments regarding this document, its contents, or distribution should be directed to this office.

Gerald L. Hunt

APPROVED BY:

John P. Mayer
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Enclosure

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FM13/GLHunt:js 3-8-67

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MAR - 9 1967

05952-H161-R0-00

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO.67-FM-32

3 MARCH 1967

EFFECT OF LAUNCH VEHICLE DESTRUCT ACTION ON SERVICE MODULE, LUNAR MODULE AND SPACECRAFT LM ADAPTER FOR MISSION AS-503

BY

APOLLO ENGINEERING OPERATIONS DEPARTMENT,

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05952-H164-TO-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34-A

NAS 9-4810 1 MARCH 1967

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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05952-H165-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-34

10 MARCH 1967

AS-501 ALTERNATE MISSION ENTRY HAZARDS EVALUATION - S-IVB SECOND BURN IGNITION FAILURE

Prepared By

Florida Operations, TRW Systems

MISSION PLANNING AND ANALYSIS DIVISION

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MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT

SYSTEMS ANALYSIS PROGRAM

NAS 9-4810

15 MARCH 1967

Prepared for

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TRW NOTE NO. 67-FMT-499

PROJECT APOLLO
TASK MSC/TRW A-135

GUIDANCE ANALYSIS HIGH SPEED PROGRAM (GAHSP) SCHEMATIC LOGIC FLOW

31 MARCH 1967

Prepared for
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05952-H169-R0-00

MISSION REQUIREMENTS
FOR
APOLLO 7
CSM DEVELOPMENT MISSION

NAS 9-4810

1 May 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-48

TRW NOTE NO. 67-FMT-500

PROJECT APOLLO
TASK MSC/TRW A-126

LM LANDING RADAR AND ABORT GUIDANCE SYSTEM SIMULATIONS FOR ARMP

31 MARCH 1967

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 67-FMT-501

PROJECT APOLLO
TASK MSC/TRW A-54.1

DESCRIPTION OF PROC STATISTICAL PROCESSOR PROGRAM

1 JULY 1967

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TRW SYSTEMS

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TRW NOTE NO. 67-FMT-502

PROJECT APOLLO
TASK MSC/TRW A-105

OPERATING INSTRUCTIONS AND CARD FORMATS FOR NPR

3 APRIL 1967

Prepared for
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TRW SYSTEMS

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PROJECT TECHNICAL REPORT

TASK ASPO-45

PROPOSED THERMAL PROTECTION SYSTEM DATA REDUCTION SCHEME

28 March 1967

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NAS 9-4810

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MSC INTERNAL NOTE NO. 67-FM-5

PROJECT APOLLO

TASK MSC/TRW A-21

APOLLO MISSION AS-206 SPACECRAFT OPERATIONAL TRAJECTORY VOLUME II, TRAJECTORY LISTING

1 APRIL 1967

MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

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PROJECT TECHNICAL REPORT
TASK ASPO-19B

ENGINEERING MODEL FOR THE LM DESCENT PROPULSION SYSTEM SUPERCRITICAL PRESSURIZING SYSTEM

NAS 9-4810

15 JUNE 1967

REVISION 1

Prepared for
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PROJECT TECHNICAL REPORT
TASK ASPO-19B

ENGINEERING MODEL FOR THE LM DESCENT PROPULSION SYSTEM SUPERCRITICAL PRESSURIZING SYSTEM

NAS 9-4810

14 APRIL 1967

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TRW NOTE NO. 67-FMT-503

PROJECT APOLLO
TASK MSC/TRW A-60.5

ONBOARD MANUAL ABORT ANALYSIS SUMMARY REPORT

10 APRIL 1967

Prepared for
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05952-H180-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-48

RADIATOR CORRELATIONS FOR PARAMETRIC ANALYSIS APOLLO BLOCK II SPACECRAFT

NAS 9-4810

14 APRIL 1967

Prepared for
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TRW SYSTEMS

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

QUARTERLY PROGRESS REPORT

ASPO TASK 34A

NAS 9-4810 7 APRIL 1967

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9B
TECHNICAL REPORT

ANALYSIS OF THE LM DOWNLINK PM MODE 4 WITH BACKUP VOICE AND LOW BIT RATE TELEMETRY

27 FEBRUARY 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-48

05952-H184-R0-00

BIMONTHLY PROGRESS REPORT

APOLLO APPLICATIONS MISSION
TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 APRIL 1967

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05952-H185-R0-00

BIMONTHLY PROGRESS REPORT

GEMINI MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 APRIL 1967

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TRW NOTE NO. 67-FMT-507

PROJECT APOLLO
TASK MSC/TRW A-98

REAL-TIME PROGRAM VERIFICATION OF THE AS-501 REENTRY GUIDANCE EQUATIONS

17 MAY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW SYSTEMS

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05952-H188-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 APRIL 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

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NARA SW Box E209H-49

05952-H190-R0-00

TRW NOTE NO. 67-FMT-509

PROJECT APOLLO

TASK MSC/TRW A-123

ANALYSIS OF SYSTEM/SUBSYSTEM COMPUTATIONAL SUPPORT BY THE REAL TIME AUXILIARY COMPUTING FACILITY

18 APRIL 1967

Prepared by
Manned Spacecraft Systems Laboratory

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MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 67-FMT-510

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE TEST PLAN FOR LGC DIGITAL AUTOPILOT TESTS

9 MAY 1967

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 67-FMT-514

PROJECT APOLLO
TASK MSC/TRW A-117

GEOGRAPHIC LOCI OF APOLLO TRANSLUNAR INJECTION BURNS AND FREE RETURN TOUCHDOWN POSITIONS

VOLUME 1
FEBRUARY - APRIL 1968

5 MAY 1967

Prepared for
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05952-H193-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-38

AS-501 GUIDANCE NAVIGATION AND CONTROL SYSTEM FLIGHT TEST ANALYSIS PLAN

NAS 9-4810

20 APRIL 1967

Prepared for
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NARA SW Box E209H-49

05952-H196-R0-00

PROJECT TECHNICAL REPORT

TASK MSC/TRW ASPO-13D

LAUNCH MISSION RULES INPUTS FOR APOLLO SATURN DEVELOPMENT MISSION AS-501

NAS 9-4810

21 APRIL 1967
Supersedes 26 January 1967

Prepared for
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05952-H197-RO-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-66

1 MAY 1967

ATMOSPHERIC ENTRY GROUND SUPPORT DISPLAYS FOR THE MISSION CONTROL CENTER - AS-501

By Mission Dynamics Section,
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05952-H198-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-38

AS-202 GUIDANCE AND NAVIGATION ERROR ANALYSIS - FINAL REPORT

NAS 9-4810

1 MAY 1967

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TRW NOTE NO. 67-FMT-511

PROJECT APOLLO

TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE VALIDATION TEST RESULTS FOR MISSION AS-501

5 JUNE 1967

Prepared for
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05952-H183-R0-00

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 APRIL 1967

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PHASE 2 REPORT

APOLLO SPACECRAFT SYSTEMS

PERFORMANCE EVALUATION STUDY

1 JUNE 1966

Prepared for

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

Houston, Texas

ASSAP Task 13A

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FLIGHT TEST DOCUMENTATION

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2134-H001-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO-16B

APOLLO POSTFLIGHT DATA PROCESSING REQUIREMENTS MISSION AS-202

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

3 MAY 1966

TRW SYSTEMS

NARA SW Box E209H-4

2134-H001-R0-001

PROJECT TECHNICAL REPORT
TASK ASPO-16B

APOLLO POSTFLIGHT DATA PROCESSING REQUIREMENTS MISSION AS-202-REVISION 1

2 JUNE 1966

Prepared for
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5.10.16

Lap
File

2134-6001-TU000
NAS 9-4810

APOLLO SYSTEM TEST

PERFORMANCE ANALYSIS REQUIREMENTS

24 AUGUST 1965

76

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2140-H001-T0-000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
MONTHLY PROGRESS REPORT
ASPO TASK 34

RADAR PERFORMANCE ASSESSMENT

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

1 MAY 1966

TRW SYSTEMS

NARA SW Box E209H-4

2132-6015-R0000

PHASE I REPORT

APOLLO SPACECRAFT SYSTEMS
PERFORMANCE EVALUATION STUDY

15 FEBRUARY 1966

Prepared for

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*66-12575

TRW SYSTEMS

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TRW NOTE NO. 67-FMT-513

PROJECT APOLLO
TASK MSC/TRW A-121/AMENDMENT 1

RANGE DIFFERENCE DOPPLER THEORY AND DOUBLE PRECISION NUMERICAL COMPARISON

12 MAY 1967

Prepared for
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TRW NOTE NO. 67-FMT-515

PROJECT APOLLO
TASK MSC/TRW A-125

LM DESCENT ANALYSIS

12 MAY 1967

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34A

NAS 9-4810

9 May 1967

RADAR PERFORMANCE ASSESSMENT

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05952-H206-R0-00

PROJECT APOLLO

TASK MSC/TRW A- 97

BLOCK II INITIALIZATION PROCESSOR USER'S GUIDE

1 MAY 1967

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05952-H208-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 MAY 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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LM AND CSM S-BAND ANTENNA TRACKING STUDIES (PRELIMINARY REPORT)

ANALYSIS OF THE LM ANTENNA TRACKING SYSTEM

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10 MAY 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

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05952-H210-R0-00

PROJECT TECHNICAL REPORT

TASK ASPO 47

AN INVESTIGATION OF SOIL EROSION DURING LM LUNAR LANDING

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May 1967

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

Contract: NAS9-4810

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

PROJECT TECHNICAL REPORT

ASPO TASK 34B

NAS 9-4810

1 JUNE 1967

LM LANDING RADAR EVALUATION PROGRAM (LRTRW1)

Prepared for

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

PROJECT TECHNICAL REPORT

ASPO TASK 34A

NAS 9-4810 1 JUNE 1967

RESULTS OF LM LANDING RADAR EVALUATION PROGRAM (LRTRWI)

Prepared for

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

PROJECT TECHNICAL REPORT

ASPO TASK 34A

NAS 9-4810

15 May 1967

ANALYTICAL FORMULATION OF THE LANDING RADAR BORESIGHT TEST DATA REDUCTION PROGRAM

Prepared for

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TRW NOTE NO. 67-FMT-518

PROJECT APOLLO
TASK MSC/TRW A-139

APOLLO LUNAR LANDING MISSION EARTH-PHASE ABORT SENSITIVITY STUDY

5 JUNE 1967

Prepared for
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TRW SYSTEMS

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05952-H201-R0-00

TRW NOTE NO. 67-FMT-512

PROJECT APOLLO

TASK MSC/TRW A-105

OPERATING INSTRUCTIONS AND CARD FORMATS FOR AGSIM

1 MAY 1967

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05952-H218-R0-01

APOLLO COMMUNICATION SYSTEMS
TASK E-9C
TECHNICAL REPORT

APOLLO COMMUNICATION COMPATIBILITY ANALYSIS FOR MISSION AS-501 ADDENDUM - 1 OCTOBER TRAJECTORY

10 OCTOBER 1967

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-51

05952-H218-RO-02

*68-16856

APOLLO COMMUNICATION SYSTEMS
TASK E-9C
TECHNICAL REPORT

APOLLO COMMUNICATION COMPATIBILITY ANALYSIS FOR MISSION AS-501 ADDENDUM - 1 NOVEMBER TRAJECTORY

Keep

18 OCTOBER 1967

Prepared for

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. EB-R-67-3

JUNE 5, 1967

APOLLO COMMUNICATION COMPATIBILITY ANALYSIS FOR MISSION AS-501

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TRW NOTE NO. 67-FMT-519

PROJECT APOLLO
TASK MSC/TRW A-100

OPERATING INSTRUCTIONS FOR THE STOCHASTIC SIMULATION AND ANALYSIS PROGRAM

23 JUNE 1967

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TRW SYSTEMS

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05952-H220-R0-00

PROJECT TECHNICAL REPORT
TASK MSC/TRW ASPO 19B-1

FINAL PERFORMANCE CHARACTERIZATION FOR THE SPS BLOCK II ENGINE

NAS 9-4810

30 JUNE 1967

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TRW NOTE NO. 67-FMT-520

PROJECT APOLLO
TASK MSC/TRW A-97

DRAFT OF
APOLLO GUIDANCE SOFTWARE VERIFICATION PLAN

29 MAY 1967

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34A

NAS 9-4810 9 JUNE 1967

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-51

TRW NOTE NO. 67-FMT-522

PROJECT APOLLO
TASK MSC/TRW A-117

GEOGRAPHIC LOCI OF APOLLO TRANSLUNAR INJECTION BURNS AND FREE RETURN TOUCHDOWN POSITIONS

VOLUME II
MAY - JULY 1968

23 JUNE 1967

Prepared for
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05952-H227-R0-00

BIMONTHLY PROGRESS REPORT

GEMINI MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 JUNE 1967

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NAS 9-4810

15 JUNE 1967

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05952-H230-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 JUNE 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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FIRST QUARTERLY PROGRESS REPORT

TASK ASPO-45

05952-H231-R0-00

VOLUME I

TECHNICAL EVALUATION

23 June 1967

Prepared for
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Manned Spacecraft Center
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NAS 9-4810

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APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9C
TECHNICAL REPORT

DEGRADATION OF THE DOWNLINK TELEMETRY BY INTERMODULATION PRODUCTS GENERATED IN THE TRANSPONDER UPLINK TURNAROUND

26 MAY 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-51

05952-H233-R0-00

TRW NOTE NO. 67-FMT-523

PROJECT APOLLO

TASK MSC/TRW A-134

INJECTION SHIP POSITIONING TECHNIQUE FOR APOLLO LUNAR MISSIONS

23 JUNE 1967

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TRW NOTE NO. 67-FMT-525

PROJECT APOLLO
TASK MSC/TRW A-97

PRELIMINARY RESULTS OF SELECTED INDEPENDENT FLIGHT SOFTWARE VALIDATION TESTS OF THE LM-1 MISSION

30 JUNE 1967

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TRW NOTE NO. 67-FMT-526

PROJECT APOLLO
TASK MSC/TRW A-134

APOLLO CISLUNAR AND LUNAR ORBIT ATTITUDE CONSTRAINTS AND ENVELOPES ADDENDUM 1

VOLUME I

1 OCTOBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS
NAS 9-4810

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05952-H239-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-39B

THREE DIMENSIONAL VIBRATIONAL MODES OF THE APOLLO CSM/LM DOCKED VEHICLE

NAS 9-4810

30 JUNE 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-52

05952-H240-R0-00

TECHNICAL NOTE

TASK ASPO-5

FAILURE MODE EFFECTS ANALYSIS
A STATUS REVIEW

NAS 9-4810

23 JUNE 1967

Prepared for
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LM AND CSM S-BAND ANTENNA TRACKING STUDIES ASPO TASK 53

ANALYSIS OF THE LM ANTENNA TRACKING SYSTEM

---

1 JULY 1967

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Contract No. NAS 9-4810

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NARA SW Box E209H-52

05952-H242-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE 67-FM-86

15 AUGUST 1967

FLIGHT DYNAMICS DISPLAY PLOTBOARDS FOR THE 204/LM-1 MISSION

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TRW NOTE NO. 67-FMT-530

PROJECT APOLLO
TASK MSC/TRW A-98

AGC VERIFICATION OF THE AS-501 REENTRY GUIDANCE EQUATIONS

16 AUGUST 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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05952-H245-R0-00

TRW NOTE NO. 67-FMT-531

PROJECT APOLLO
TASK MSC/TRW A-105

APOLLO COASTING FLIGHT NAVIGATION SIMULATION-OBSIM/NAVSIM PROGRAM FORMULATION

25 JULY 1967

Prepared for
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NARA SW Box E209H-52

FIRST QUARTERLY PROGRESS REPORT

TASK ASPO-45

05952-R232-R0-00

VOLUME II

DATA

23 June 1967

Prepared for
National Aeronautics and Space Administration
Manned Spacecraft Center
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NAS 9-4810

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TRW NOTE NO. 67-FMT-532

PROJECT APOLLO
TASK MSC/TRW A-105

OBSIM AND NAVSIM DETAILED SUBROUTINE AND PROGRAM DESCRIPTION BOOK 1, OBSIM

21 AUGUST 1967

Prepared for
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TRW NOTE NO. 67-FMT-533

PROJECT APOLLO
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OBSIM AND NAVSIM DETAILED SUBROUTINE AND PROGRAM DESCRIPTION BOOK 2, NAVSIM

21 AUGUST 1967

Prepared for
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05952-H249-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-99

30 AUGUST 1967

MISSION AS-501 CM/SM SEPARATION AND RECONTACT ANALYSIS - ENTRY PHASE

By Mission Simulation Department
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APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9C
TECHNICAL REPORT

SUPPLEMENTARY PCM BIT ERROR RATE AND SIGNAL-TO-NOISE RATIO TEST PREDETECTIONS ON THE APOLLO S-BAND COMMUNICATION SYSTEM

14 JULY 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

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NARA SW Box E209H-53

LM AND CSM S-BAND ANTENNA TRACKING STUDIES ASPO TASK 53

PRELIMINARY ANALYSIS OF THE CSM ANTENNA TRACKING SYSTEM

15 JULY 1967

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-53

05952-H253-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-39B

APOLLO COMMAND MODULE-SERVICE MODULE INTERFACE ANALYSIS, BLOCK II SINGLE SWAY BRACE CONFIGURATION

NAS 9-4810

21 JULY 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NARA SW Box E209H-53

PROJECT TECHNICAL REPORT
TASK ASPO-39B

APOLLO COMMAND MODULE-SERVICE MODULE INTERFACE ANALYSIS, BLOCK II SINGLE SWAY BRACE CONFIGURATION ADDENDUM

NAS 9-4810

21 AUGUST 1967

Prepared for
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TRW SYSTEMS

NARA SW Box E209H-53

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

QUARTERLY PROGRESS REPORT

ASPO TASK 34A

RADAR PERFORMANCE ASSESSMENT

NAS 9-4810

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13 JULY 1967

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TRW NOTE NO. 67-FMT-539

PROJECT APOLLO
TASK MSC/TRW A-60.1

ANALYTIC RETURN-TO-EARTH PROGRAM-MOON REFERENCE

24 JULY 1967

Prepared for
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05952-H246-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 JULY 1967

Prepared for
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05952-H259-R0-00

TRW NOTE NO. 68-FMT-541

PROJECT APOLLO
TASK MSC/TRW A-150

DEVELOPMENT OF ENTRY CORRIDORS FOR THE APOLLO NEAR-EARTH ORBITAL MISSIONS

19 JANUARY 1968

Prepared for
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NAS 9-4810

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TRW NOTE NO. 67-FMT-542

PROJECT APOLLO

TASK MSC/TRW A-105

AGSIM DETAILED SUBROUTINE AND PROGRAM DESCRIPTION

4 AUGUST 1967

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TRW NOTE NO. 67-FMT-544

PROJECT APOLLO
TASK MSC/TRW A-77

EVALUATION OF THE MIT CROSS PRODUCT STEERING WITH THE LAMBERT ROUTINE FOR THE TLI BURN USING IMPROVED BURN SIMULATION POLYNOMIALS FOR TARGETING

31 JULY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NAS 9-4810

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05952-H263-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

PROJECT TECHNICAL REPORT

ASPO TASK 34B

NAS 9-4810

14 JULY 1967

GEOMETRIC TRANSFORMATIONS ASSOCIATED WITH PROJECT PEARL

Prepared for

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HOUSTON, TEXAS

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PGW

TRW NOTE NO. 67-FMT-545

PROJECT APOLLO
TASK MSC/TRW A-77

EMPIRICAL SIMULATIONS OF THE TRANSLUNAR INJECTION BURN FOR NOMINAL AND ALTERNATE MISSIONS

31 JULY 1967

Prepared for
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NAS 9-4810

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05952-H266-R0-00

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TRW NOTE NO. 66-FMT-543

PROJECT APOLLO

TASK MSC/TRW A-105

LM AGS COASTING FLIGHT NAVIGATION SIMULATION-COMPUTER PROGRAM FORMULATION

24 AUGUST 1967

Prepared for
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NARA SW Box E209H-54

05952-H267-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-109

18 AUGUST 1967

REAL-TIME AUXILIARY COMPUTING FACILITY SOFTWARE DEVELOPMENT AND VERIFICATION GUIDELINES

By Flight Analysis Branch, NASA/MSC, And Mission Operations Section, TRW Systems

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TRW NOTE NO. 67-FMT-535

PROJECT APOLLO
TASK MSC/TRW A-134

PRELIMINARY SHIP POSITIONING DATA; VOLUME I, JANUARY-MARCH 1969

22 AUGUST 1967

Prepared for
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NAS 9-4810

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21-2009

05952-H270-R0-00

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APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 AUGUST 1967

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05952-H271-R0-00

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APOLLO APPLICATIONS MISSION
TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 AUGUST 1967

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TRW NOTE NO. 67-FMT-538

PROJECT APOLLO
TASK MSC/TRW A-117

GEOGRAPHIC LOCI OF APOLLO TRANSLUNAR INJECTION BURNS AND FREE RETURN TOUCHDOWN POSITIONS

VOLUME III
AUGUST - OCTOBER 1968

21 AUGUST 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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05952-H273-R0-00

PROJECT TECHNICAL REPORT

TASK E-34C

EXACT EVALUATION OF A DETERMINISTIC ERROR IN THE LM LR ALTIMETER CHANNEL

NAS 9-4810

12 FEBRUARY 1968

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-55

05952-H274-RO-OO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-141

SEPTEMBER 18, 1967

PASSIVATION STUDY FOR APOLLO MISSION AS-204/LM-1 VOLUME II DUMP AND VENT MODEL

By Mission Simulation Department,
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05952-H275-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-151

SEPTEMBER 28, 1967

MISSION AS-501 SEPARATION AND RECONTACT ANALYSIS

By Mission Simulation Department
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05952-H276-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO - 38

FOUNDATIONS FOR A GUIDANCE AND CONTROL FLIGHT TEST PLAN

NAS 9-4810

10 AUGUST 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-55

APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9C
TECHNICAL REPORT

THEORETICAL PREDICTIONS FOR ACS - PHASE II UPDATA TESTS

15 AUGUST 1967

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-55

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
MONTHLY PROGRESS REPORT
ASPO TASK 34B

NAS 9-4810

9 August 1967

RADAR PERFORMANCE ASSESSMENT

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-55

05952-H279-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-124

December 6, 1967

PRELIMINARY DISPERSION ANALYSIS OF THE FIRST ACTIVE RENDEZVOUS OF THE AS-207/206/103/LM-2 MISSION

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TRW NOTE NO. 67-FMT-547

PROJECT APOLLO
TASK MSC/TRW A-134

PRELIMINARY SHIP POSITIONING DATA; VOLUME II, APRIL-JUNE 1969

1 SEPTEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NAS 9-4810

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-128

1 November 1967

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TRW NOTE NO. 67-FMT-548

PROJECT APOLLO
TASK MSC/TRW A-97

RESULTS OF INDEPENDENT FLIGHT SOFTWARE VALIDATION TEST OF THE BURST116 PROGRAM FOR THE LM-1 MISSION

28 SEPTEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-126

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1 September 1967

APOLLO MISSION AS-501/017 CONSUMABLES ANALYSIS

By Consumables Analysis Section
With Support From TRW Systems

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701-2061

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Cy #3

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROGRAM

15 AUGUST 1967

Prepared for
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TRW NOTE NO. 67-FMT-551

PROJECT APOLLO
TASK MSC/TRW A-134

PRELIMINARY SHIP POSITIONING DATA; SUPPLEMENT TO VOLUME I AND VOLUME II, JANUARY - JUNE 1969

11 SEPTEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 67-FMT- 553

PROJECT APOLLO

TASK MSC/TRW AA-17

SOLUTION TECHNIQUES FOR AAP CONSUMABLES ANALYSIS

1 SEPTEMBER 1967

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TRW NOTE NO. 67-FMT-552

PROJECT APOLLO
TASK MSC/TRW A-135

GAHS PROGRAM DESCRIPTION AND USERS' GUIDE

19 SEPTEMBER 1967

Prepared for
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APOLLO COMMUNICATION SYSTEMS
ASPO TASK 9C
TECHNICAL REPORT

PRELIMINARY UNIFIED S-BAND COMMUNICATION SYSTEM ABORT MODE ANALYSIS

8 SEPTEMBER 1967

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Under
Contract No. NAS 9-4810

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TRW NOTE NO. 67-FMT-554

PROJECT APOLLO
TASK MSC/TRW A-134

PRELIMINARY RADAR SHIP ANALYSIS PROGRAM

3 NOVEMBER 1967

Prepared for
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TRW NOTE NO. 67-FMT-555

PROJECT APOLLO
TASK MSC/TRW A-134

PRELIMINARY SHIP POSITIONING DATA; VOLUME III, JULY - SEPTEMBER 1969

11 OCTOBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW NOTE NO. 67-FMT-556

PROJECT APOLLO
TASK MSC/TRW A-126

SIMPLIFIED OPERATIONAL PROCESSOR FOR LM POWERED DESCENT MONITORING DISPLAYS

18 SEPTEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW NOTE NO. 67-FMT-550

PROJECT APOLLO
TASK MSC/TRW A-117

GEOGRAPHIC LOCI OF APOLLO TRANSLUNAR INJECTION BURNS AND FREE RETURN TOUCHDOWN POSITIONS

VOLUME IV
OCTOBER - DECEMBER 1968

11 SEPTEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NAS 9-4810

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05952-H295-R0-00

TRW NOTE NO. 67-FMT-558

PROJECT APOLLO
TASK MSC/TRW A-117

GEOGRAPHIC LOCI OF APOLLO TRANSLUNAR INJECTION BURNS AND FREE RETURN TOUCHDOWN POSITIONS

VOLUME V
JANUARY - MARCH 1969

9 OCTOBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 67-FMT-559

PROJECT APOLLO
TASK MSC/TRW A-125

LM DESCENT ANALYSIS
ABORTS FROM POWERED DESCENT

27 SEPTEMBER 1967

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
MONTHLY PROGRESS REPORT
ASPO TASK 34B

NAS 9-4810

11 September 1967

RADAR PERFORMANCE ASSESSMENT

Prepared for

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05952-H300-R0-00

PROJECT TECHNICAL REPORT

TASK ASPO-39B

THREE DIMENSIONAL VIBRATION MODES FOR FULL-FUEL CSM/LM DOCKED VEHICLE

NAS 9-4810

29 SEPTEMBER 1967

Prepared for
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NARA SW Box E209H-57

OCT 17 1967

05952-H302-R0-00

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

15 OCTOBER 1967

Prepared for
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APOLLO APPLICATIONS MISSION
TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 OCTOBER 1967

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APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

15 OCTOBER 1967

Prepared for
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05952-H294-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

15 SEPTEMBER 1967

Prepared for
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PROJECT TECHNICAL REPORT

TASK MSC/TRW E-19C

APOLLO 4
501/017/LTA-10R
SERVICE PROPULSION SYSTEM
FLIGHT EVALUATION PLAN

NAS 9-4810

13 OCTOBER 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW NOTE NO. 67-FMT-560

PROJECT APOLLO
TASK MSC/TRW A-117

GEOGRAPHIC LOCI OF APOLLO TRANSLUNAR INJECTION BURNS AND FREE RETURN TOUCHDOWN POSITIONS

VOLUME VI
APRIL - JUNE 1969

7 NOVEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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05952-H309-R0-00

APOLLO COMMUNICATION SYSTEMS
TASK E-9D
TECHNICAL REPORT

THEORETICAL PREDICTIONS FOR THE USB-CSM BLOCK II VOICE CHANNELS AND THE LM VOICE AND TELEMETRY CHANNELS

13 OCTOBER 1967

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Under
Contract No. NAS 9-4810

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TRW NOTE NO. 67-FMT-563

PROJECT APOLLO
TASK MSC/TRW A-134

PRELIMINARY SHIP POSITIONING DATA; VOLUME IV, OCTOBER - DECEMBER 1969

25 OCTOBER 1967

Prepared for
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05952-H315-R0-00

APOLLO COMMUNICATION SYSTEMS
TASK E-9D
TECHNICAL REPORT

ANALYSIS OF TELEMETRY DEGRADATION DUE TO BACKUP VOICE INTERFERENCE

20 OCTOBER 1967

Prepared for

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TRW NOTE NO. 67-FMT-566

PROJECT APOLLO
TASK MSC/TRW A-145

THE DEVELOPMENT AND PERFORMANCE OF THE ATMOSPHERIC SIMULATOR AND CARBON DIOXIDE REMOVAL SYSTEM COMPUTER PROGRAM PROGRAM NO. HX-105A USER'S MANUAL

16 OCTOBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 67-FMT-565

PROJECT APOLLO
TASK MSC/TRW A-141

FEASIBILITY OF REAL-TIME UTILIZATION OF REENTRY TRACKING SHIP AND REENTRY AIRCRAFT DATA

31 OCTOBER 1967

Prepared for
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05952-H306-R0-00

PROJECT TECHNICAL REPORT
TASK E&D-38A

LM-1 GUIDANCE NAVIGATION AND CONTROL SYSTEM FLIGHT TEST ANALYSIS PLAN

NAS 9-4810

20 OCTOBER 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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LM AND CSM S-BAND ANTENNA
TRACKING STUDIES
TASK E - 53A

TECHNICAL REPORT

PRELIMINARY ANALYSIS OF THE LM AND CSM ANTENNA TRACKING SYSTEMS

---

24 OCTOBER 1967

Prepared for

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Under
Contract No. NAS 9-4810

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TRW NOTE NO. 67-FMT-567

PROJECT APOLLO
TASK MSC/TRW A-103

APOLLO REFERENCE MISSION PROGRAM SIX-DEGREE-OF-FREEDOM GUIDANCE AND CONTROL USERS MANUAL

1 NOVEMBER 1967

Prepared for
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TRW NOTE NO. 67-FMT-570

PROJECT APOLLO
TASK MSC/TRW A-60.1

LANDING SITE ACCESSIBILITY PLOT PROGRAM MOON REFERENCE

27 FEBRUARY 1968

Prepared for
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05952-H323-R0-00

TECHNICAL NOTE

TASK E-38

APOLLO 4

GN&C PREFLIGHT PERFORMANCE REVIEW

NAS 9-4810

2 NOVEMBER 1967

Prepared for
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TRW NOTE NO. 68-FMT-683

PROJECT APOLLO
TASK MSC/TRW A-130

APOLLO BLOCK DATA PROGRAM USER'S MANUAL (REVISION 1)

20 SEPTEMBER 1968

Prepared for
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05952-H319-R0-00

TRW NOTE NO. 67-FMT-566

MSC/TRW APOLLO PROGRAM
MANAGEMENT TASK

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION CONTRACTOR FINANCIAL MANAGEMENT REPORT COMPUTERIZED FORM 533 DOCUMENTATION

23 OCTOBER 1967

Prepared by
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Prepared for
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TRW No. 2141-6001-RU000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

OVERALL CRITICAL PARAMETER CONTROL PLAN

29 October 1965

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Contract No. NAS 9-4810

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR MASS PROPERTIES

29 October 1965

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR MASS PROPERTIES (REVISION A)

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NAS 9-4810

15 December 1965

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TRW No. 2141-6003-RU000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR
VELOCITY-TO-BE-GAINED CAPACITY

29 October 1965

Prepared for

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PROGRAM TECHNICAL REPORT
TASK ASPO 12

ADDITIONAL BLOCK II CSM ATTITUDE CONTROL MODE BLOCK DIAGRAMS FOR LUNAR PERFORMANCE VALIDATION

NAS 9-4810

1 APRIL 1966

Prepared for
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TRW No. 2141-6004-RU000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR ATTITUDE CONTROL IMPULSE CAPACITY

29 October 1965

Prepared for
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Contract No. NAS 9-4810

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TRW No. 2141-6005-RU000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR
ELECTRICAL POWER CAPACITY

29 October 1965

Prepared for
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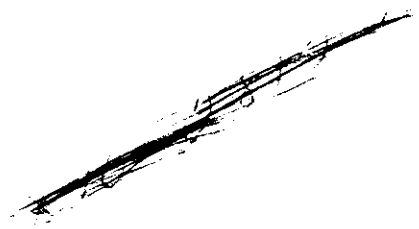
Contract No. NAS 9-4810



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TRW No. 2141-6006-RU000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR COMMUNICATIONS CAPACITY

29 October 1965

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Contract No. NAS 9-4810

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR
THERMAL CONTROL CAPACITY

29 October 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-5

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO-15 (SUBTASK 1)

CONTROL PLAN FOR WATER MANAGEMENT CAPACITY

29 October 1965

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-5

2142-H004-R0-000

PROGRAM TECHNICAL REPORT
TASK ASPO 12 - (4)

APOLLO SPACECRAFT DESIGN HEATING TRAJECTORIES FOR SATURN V VEHICLES

NAS 9-4810

13 JUNE 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-5

2142-H005-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO-12

CSM MECHANIZATION VALIDATION AND ERROR ANALYSIS FINAL REPORT

NAS 9-4810

15 JUNE 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW SYSTEMS

NARA SW Box E209H-5

Block II CSM Attitude Control Mode Block Diagrams for the Lunar Performance Validation Task (ASSAP Task 12.1)

2142-6001-RU-000 2 November 1965

Contract No. NAS 9-4810

TRW SPACE TECHNOLOGY LABORATORIES

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2142-6002-TO-00

APOLLO SPACECRAFT
LUNAR MISSION PERFORMANCE VALIDATION

Monthly Progress Report

ASSAP TASK 12

1 MARCH 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas

Under
Contract No. NAS9-2938

TRW SYSTEMS

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PROJECT TECHNICAL REPORT

TASK ASPO-15

ELECTRICAL POWER MANAGEMENT PROGRAM PLANNING GUIDE FOR CSM AND LEM

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

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NAS 9-4810

26 November 1965

TRW SYSTEMS

NARA SW Box E209H-5

CSM SCS DISPLAY MODE OPTIONS
(ASPO TASK 12.1)

Prepared By: R. Boudreau

2142-H001-TU-000 10 November 1965

Contract No. NAS 9-4810

TRW SPACE TECHNOLOGY LABORATORIES
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NARA SW Box E209H-5

05952-H326-R0-00
EB67-3738(U)

APOLLO COMMUNICATIONS SYSTEMS
TASK E-59A
TECHNICAL REPORT

LM DIGITAL UPLINK ASSEMBLY PERFORMANCE

10 NOVEMBER 1967

TRW SYSTEMS
HOUSTON OPERATIONS
TECHNICAL LIBRARY

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-60

TRW NOTE NO. 67-FMT-573

PROJECT APOLLO
TASK MSC/TRW A-108

TRACKING DATA PREPROCESSOR USERS GUIDE

28 DECEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NAS 9-4810

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05952-H327-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM- 7

January 3, 1968

MISSION B-1/LM-1 (APOLLO 5) SEPARATION AND RECONTACT ANALYSIS

S-IVB/LM-1 SEPARATION

VOLUME I

PRA/ATCA CONTROL

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

MSC Task Monitor
M. L. Williamson

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05952-H328-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-130

DECEMBER 31, 1967

AGC LAUNCH DISPLAY PARAMETER ANALYSIS FOR MANNED MISSIONS

By Spaceflight Operations Department
TRW Systems Group

MSC Task Monitor
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05952-H329-R0-00

TRW NOTE NO. 67-FMT-574

PROJECT APOLLO

TASK MSC/TRW AA-11

SOLAR PANEL ATTITUDE STUDY FOR AAP ORBITAL WORKSHOP MISSIONS

17 NOVEMBER 1967

Prepared by
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Prepared for
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Apollo Files

05952-H330-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

15 NOVEMBER 1967

Prepared for
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HOUSTON, TEXAS

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SYSTEMS GROUP

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TRW NOTE NO. 67-FMT-576

PROJECT APOLLO
TASK MSC/TRW A-105

NAVIGATION ANALYSIS STUDY
CSM ACTIVE RENDEZVOUS

20 NOVEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS
NAS 9-4810

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TRW NOTE NO. 67-FMT-572

PROJECT APOLLO
TASK MSC/TRW A-130

PROGRAMMING MANUAL FOR THE APOLLO BLOCK DATA PROGRAM

4 DECEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NAS 9-4810

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TRW NOTE NO. 67-FMT-579

PROJECT APOLLO
TASK MSC/TRW A-97

LGC/RTCC COMPATIBILITY VERIFICATION RESULTS USING THE LM-1 BURST 116 FLIGHT PROGRAM

27 DECEMBER 1967

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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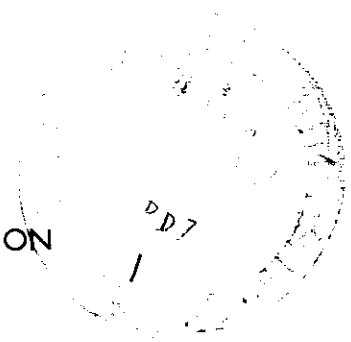
05952-H339-R0-00

PROJECT TECHNICAL REPORT
TASK E-45A

SECOND QUARTERLY PROGRESS REPORT, VOLUME I

NAS 9-4810

16 NOVEMBER 1967



Prepared for
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05952-H340-R0-00

PROJECT TECHNICAL REPORT
TASK E-45A

SECOND QUARTERLY PROGRESS REPORT, VOLUME II

NAS 9-4810

16 NOVEMBER 1967

Prepared for
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TRW SYSTEMS

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TRW NOTE NO. 67-FMT-577

PROJECT APOLLO
TASK MSC/TRW A-146

MASS PROPERTIES PROGRAM (MASPRO) HX 201A

1 DECEMBER 1967

Prepared for
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1. Problem Description
2. Input
3. Output
4. Operating
5. Operating

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05952-H341-R0-01

APOLLO COMMUNICATION SYSTEMS
TASK E-9D
TECHNICAL REPORT

APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION AS-204/LM-1 ADDENDUM - 16 JANUARY 1968 TRAJECTORY

---

16 JANUARY 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-62

05952-H342-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO 39B

THREE DIMENSIONAL VIBRATION MODES FOR HALF-FULL CSM/LM DOCKED VEHICLE

NAS 9-4810

20 NOVEMBER 1967

Prepared for
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TRW SYSTEMS

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05952-H343-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-146

December 7, 1967

REAL - TIME AUXILIARY COMPUTING FACILITY LV-501/CSM-017 MISSION REPORT

By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
TRW Systems Group

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05952-H346-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-190

DECEMBER 11, 1967

APOLLO MISSION AS-204/LM-1 SPACECRAFT DISPERSION ANALYSIS

By Mission Analysis Section

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TRW NOTE NO. 67-FMT-586

PROJECT APOLLO
TASK MSC/TRW A-149

TRANSEARTH INJECTION ABORT PROCESSOR ENTRY RANGE FUNCTIONS

15 DECEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NAS 9-4810

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05952-H348-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 DECEMBER 1967

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

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05952-H349-R0-00

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 DECEMBER 1967

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05952-H350-R0-00

BIMONTHLY PROGRESS REPORT

APOLLO APPLICATIONS MISSION
TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 DECEMBER 1967

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TRW NOTE NO. 67-FMT-584

PROJECT APOLLO

TASK MSC/TRW A-136 AND A-54.2

APOLLO MISSIONS PROP BOX LIBRARY

VOLUME I

8 DECEMBER 1967

Prepared for
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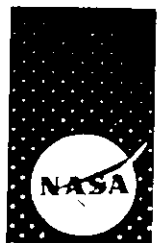
05952-H341-R0-00



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. EB-R-67-7

DECEMBER 1, 1967

APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION AS-204/LM-1

By Communications Systems Section

TRW Systems Group

MSC Task Monitor
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MANNED SPACECRAFT CENTER
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05952-H354-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34C

NAS 9-4810

11 DECEMBER 1967

RANGE COVERAGE OF THE CSM RENDEZVOUS RADAR TRANSPONDER

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-63

TRW NOTE NO. 67-FMT-589

PROJECT APOLLO
TASK MSC/TRW A-60.1

USERS MANUAL FOR THE EARTH-CENTERED ANALYTIC ABORT PROGRAM

20 DECEMBER 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NAS 9-4810

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PROJECT TECHNICAL REPORT

TASK MSC/TRW E-19C

APOLLO 5
204/LM1
LM DESCENT PROPULSION SUBSYSTEM
PREFLIGHT ANALYSIS

NAS 9-4810

15 DECEMBER 1967

Prepared for
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TRW NOTE NO. 67-FMT-593

PROJECT APOLLO
TASK MSC/TRW A-97

RESULTS OF INDEPENDENT FLIGHT SOFTWARE VALIDATION TESTING OF THE BURST 120 PROGRAM FOR THE LM-1 MISSION

22 DECEMBER 1967

Prepared for
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NAS 9-4810

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TRW NOTE NO. 68-FMT-592

PROJECT APOLLO
TASK MSC/TRW A-145

APOLLO CSM ECS/THERMAL INTEGRATED ANALYSIS PROGRAM PROGRAM NO. HX101A USERS MANUAL

30 JANUARY 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NAS 9-4810

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TRW NOTE NO. 68-FMT-588

PROJECT APOLLO
TASK MSC/TRW A-97

INDEPENDENT FLIGHT SOFTWARE VERIFICATION TEST PLAN OF THE SUNDISK PROGRAM FOR THE AS-205/101 MISSION

JANUARY 5, 1968

Prepared by
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05952-H362-R0-00
EB67-3750(U)

APOLLO COMMUNICATION SYSTEMS
TASK E-59A
TECHNICAL REPORT

APOLLO UPDATA SIGNAL CHARACTERISTICS AND CAPABILITY PERFORMANCE

22 DECEMBER 1967

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-64

05952-H363-R0-00

PROJECT TECHNICAL REPORT

TASK MSC/TRW E-19C

APOLLO 5
204/LM-1
LM MAIN PROPULSION SUBSYSTEM
FLIGHT EVALUATION PLAN

NAS 9-4810

29 DECEMBER 1967

Prepared for
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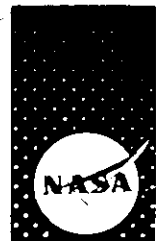
05952-H364-R0-00



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-46

February 18, 1968

FORMULATION OF RENDEZVOUS NAVIGATION PLANS FOR MISSIONS D, E, AND G

By Navigation Analysis Section
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HOUSTON, TEXAS

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TRW NOTE NO. 68-FMT-598

PROJECT APOLLO
TASK MSC/TRW A-135

GAHS PROGRAM DESCRIPTION

23 JANUARY 1968

Prepared for
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TRW NOTE NO. 68-FMT-597

PROJECT APOLLO
TASK MSC/TRW A-135

GAHS PROGRAM INPUT/OUTPUT INSTRUCTIONS

16 JANUARY 1968

Prepared for
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APOLLO COMMUNICATION SYSTEMS
TASK E-59A
TECHNICAL REPORT

LM-1 TELEMETRY SYSTEM PERFORMANCE
BIT TRANSITION DENSITY REPORT

---

5 JANUARY 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-64

05952-H369-R0-00

TRW NOTE NO. 67-FMT-599

PROJECT APOLLO

TASK MSC/TRW AA-23

FIRST CLUSTER AAP MISSIONS - ATTITUDE STUDIES
FINAL REPORT

30 December 1967

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05952-H370-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-10

January 10, 1968

THE REAL-TIME AUXILIARY COMPUTING FACILITY LV-204/LM-01 (APOLLO 5) OPERATIONAL SUPPORT TEAM HANDBOOK

By Mission Operations Section
TRW Systems Group

TRW SYSTEMS
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APOLLO COMMUNICATION SYSTEMS
TASK E-59A
TECHNICAL REPORT

CSM TELECOMMUNICATIONS SYSTEM ANALYSIS

PART I

---

5 JANUARY 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-64

05952-H372-R0-00

Cy #3

PROJECT TECHNICAL REPORT

APOLLO B/LM2
LM DESCENT PROPULSION SUBSYSTEM
PREFLIGHT ANALYSIS

NAS 9-4810

15 JANUARY 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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TRW NOTE NO. 68-FMT-601

PROJECT APOLLO
TASK MSC/TRW A-143

RECOMMENDED RTCC REQUIREMENTS FOR THE TLI GUIDANCE SWITCHOVER PROCEDURE

15 JANUARY 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NAS 9-4810

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TRW NOTE NO. 67-FMT-591

PROJECT APOLLO

TASK MSC/TRW AA-24

ANALYSIS OF PLANETARY HYPERBOLIC DEPARTURE TECHNIQUES

22 December 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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NARA SW Box E209H-64

TRW NOTE NO. 68-FMT-600

PROJECT APOLLO
TASK MSC/TRW A-97

RESULTS OF INDEPENDENT FLIGHT SOFTWARE VALIDATION TESTING OF THE DIGITAL AUTOPILOT FOR THE LM-1 MISSION

15 JANUARY 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NAS 9-4810

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05952-H377-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 JANUARY 1968

Prepared for
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05952-H378-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-51

FEBRUARY 16, 1968

PRELIMINARY LAUNCH ABORT STUDY FOR APOLLO MISSION "C"/CSM-101

By Mission Operations Section
TRW Systems Group

MSC Task Monitor
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Chapo Files

05952-H381-R0-00

PROJECT TECHNICAL REPORT
TASK E-36C

APPROACH TERRAIN EVALUATION: SITES II P-2, II P-6, II P-8, II P-11, AND II P-13

NAS 9-4810

15 JANUARY 1968

Prepared for
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AT-

05952-H383-R0-91
Cy 2

TRW NOTE NO. 68-FMT-610

PROJECT APOLLO

TASK MSC/TRW A-142
AMENDMENT NO. 3

INVESTIGATION AND IDENTIFICATION OF CONSUMABLES TO BE CONSIDERED IN CRITICAL PHASE ANALYSES REVISION 1

7 FEBRUARY 1968

Prepared by
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R. E. Nelson
Applications and Planning Department
Systems Engineering Laboratory

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05952-H386-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-31

February 29, 1968

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OPERATIONAL SUPPORT PLAN FOR THE REAL-TIME AUXILIARY COMPUTING FACILITY LV-502/CSM-020 FLIGHT ANNEX

By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
TRW Systems Group

MSC Subtask Monitor
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MANNED SPACECRAFT CENTER
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NARA SW Box E209H-65

05952-H387-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
PROJECT TECHNICAL REPORT
TASK E-34C

NAS 9-4810 2 FEBRUARY 1968

VERIFICATION OF LANDING RADAR TRANSFER FUNCTIONS

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Space Park Drive - Houston, Texas

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TRW NOTE NO. 67-FMT- 613

PROJECT APOLLO
TASK MSC/TRW A-136

TAPP VI PROGRAMMING USERS MANUAL

30 APRIL 1968

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NAS 9-4810

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PROJECT TECHNICAL REPORT

TASK MSC/TRW ASPO-61

LAUNCH MISSION RULES SUPPORT DATA FOR SPACECRAFT DEVELOPMENT MISSION APOLLO - SATURN 502/020/APOLLO 6

NAS 9-4810

31 JANUARY 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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SYSTEMS GROUP

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OPTIONAL FORM NO. 10 5010-107
GSA GEN. REG. NO. 27

UNITED STATES GOVERNMENT

Memorandum

NASA-Manned Spacecraft Center

TO : See attached list

DATE: MAR 8 1968

PD/M-109/68

FROM : PD/Chief, Systems Engineering Division

SUBJECT: Distribution of Revision B to Apollo 6 Launch Mission Rules Support Data, January 31, 1968

Please include Revision B to Apollo 6 Mission Rules Support Data, January 31, 1968.

Revision B does not change any redlines. It does, however, add the redlines for the SCS based on the results of the FRT. The remainder of the changes are revisions or additions to the redline support data or the rationale of the mandatory measurements for the objectives.

Owen E. Maynard

Enclosure

PD:DRSogna:cvs 3/26/68

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05952-H393-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-59

MARCH 1, 1968

APOLLO 6 (A-2 OR AS-502/020) SPACECRAFT OPERATIONAL ALTERNATE MISSION PLAN

By Lunar Analysis Section
TRW Systems Group

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MANNED SPACECRAFT CENTER
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GENERAL
FIRST S-IVB BURN
EARTH PARKING ORBIT
SECOND S-IVB BURN

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PROJECT TECHNICAL REPORT

TASK E&D-38

APOLLO IV GUIDANCE AND NAVIGATION ERROR ANALYSIS - FINAL REPORT

NAS 9-4810

5 FEBRUARY 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Apollo Guidance and Control
Project Office

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Gyro #3

05952-H375-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-15

JANUARY 11, 1968

MISSION B-1/LM-1 (APOLLO 5) SEPARATION AND RECONTACT ANALYSIS

S-IVB/LM-1 SEPARATION

VOLUME II

LGC/DAP CONTROL

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

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MSC Task Monitor
M.L. Williamson

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PROJECT TECHNICAL REPORT

PRELIMINARY ANALYSIS OF THE DESCENT PROPULSION SYSTEM DURING THE FLIGHT OF APOLLO 5

NAS 9-4810 31 JANUARY 1968

Prepared for
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Prepared by: PSD-Systems Analysis Department

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TRW SYSTEMS GROUP

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TRW NOTE NO. 68-FMT-609

APOLLO APPLICATIONS PROJECT
TASK MSC/TRW AA-17

REQUIREMENTS FOR CONSUMABLES BUDGETING COMPUTER PROGRAM

1 FEBRUARY 1968

Prepared for
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NAS 9-4810

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05952-H399-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM- 58

February 26, 1968

APOLLO 6 (A-2 OR AS-502/020) OPERATIONAL SPACECRAFT ABORT PLAN

By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
TRW Systems Group

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LAUNCH PHASE - LAUNCH PHASE - LAUNCH PHASE - LAUNCH PHASE - ORBIT PHASE -

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05952-H400-R0-00

PROJECT TECHNICAL REPORT
TASK E-9D

COMMUNICATION SIMULATION PROGRAM
(COMSIM) HV 008A

NAS 9-4810

7 FEBRUARY 1968

Prepared for
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05952-H401-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-77

March 8, 1968

LAUNCH PHASE ABORT ANALYSIS FOR A 50-DEGREE ORBITAL INCLINATION TRAJECTORY

By Spaceflight Operations Department

TRW Systems Group

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TRW NOTE NO. 68-FMT-615

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO MISSION 4/AS-501 TRAJECTORY RECONSTRUCTION AND POSTFLIGHT ANALYSIS - APPENDIXES

VOLUME I

12 MARCH 1968

Prepared for
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NAS 9-4810

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05952-H403-R0-01
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TRW NOTE NO. 68-FMT-615

PROJECT APOLLO

TASK MSC/TRW A-50

APOLLO MISSION 4/AS-501 TRAJECTORY RECONSTRUCTION AND POSTFLIGHT ANALYSIS - APPENDIXES

VOLUME II

12 MARCH 1968

Prepared by
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05952-H395-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-48

February 15, 1968

FIXED-ATTITUDE ABORT PROCEDURES FOR ABORTS OCCURRING DURING TRANSLUNAR INJECTION

By

Contingency Operations Section

TRW Systems Group

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05952-H407-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. EB-R-68-1

FEBRUARY 15, 1968

APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION AS-502

By Communications Systems Section
TRW Systems Group

MSC Task Monitor
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INFORMATION SYSTEMS DIVISION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

NARA SW Box E209H-67

05952-H407-R0-92

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

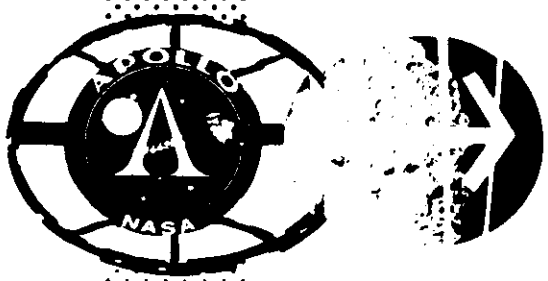
MSC INTERNAL NOTE NO. EB-R-68-4

March 25, 1968

REVISED APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION AS-502

By Communications Systems Section
TRW Systems Group

MSC Task Monitor
G. D. Arndt



INFORMATION SYSTEMS DIVISION
MANNED SPACECRAFT CENTER
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APOLLO COMMUNICATION SYSTEMS
TASK E-53B
TECHNICAL REPORT

BORESIGHT SHIFT ANALYSIS FOR THE APOLLO LM AND CSM TRACKING SYSTEMS AND COMPARISONS OF CSM TEST RESULTS WITH ANALYTICAL RESULTS

9 FEBRUARY 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-67

05952-H409-R0-00

BIMONTHLY PROGRESS REPORT

APOLLO MISSION TRAJECTORY CONTROL PROGRAM

NAS 9-4810

15 FEBRUARY 1968

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05952-H411-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 FEBRUARY 1968

Prepared for
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05952-H404-R0-00
2

TRW NOTE NO. 68-FMT-616

PROJECT APOLLO

TASK MSC/TRW A-166

PROGRAMMING MANUAL
COMMAND SERVICE MODULE ELECTRICAL POWER SYSTEM
PROGRAM HX001A

26 FEBRUARY 1968

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05952-H413-R0-01

Cy 5

TRW NOTE NO. 68-FMT-620

PROJECT APOLLO

TASK MSC/TRW A-98

REAL-TIME PROGRAM VERIFICATION OF THE APOLLO MISSION C REENTRY GUIDANCE EQUATIONS ADDENDUM 1

14 AUGUST 1968

Prepared by
Flight Analysis Section

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-45

February 16, 1968

MISSION A-2/CSM 020 (APOLLO 6) SEPARATION AND RECONTACT ANALYSIS SUMMARY DOCUMENT

By Mission Simulation Department

TRW Systems Group

and

Flight Studies Section

Flight Analysis Branch

NASA/MSC

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DMG

CHANGE SHEET

For

NASA-MSC Internal Note 68-FM-45, dated February 16, 1968

Mission A-2/CSM 020 (Apollo 6)

Separation and Recontact

Analysis

Summary Document

By Mission Simulation Department
TRW Systems Group
and
Flight Studies Section
Flight Analysis Branch
NASA/MSC

Change 1
February 23, 1968

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2. Lists of Illustrations and Tables have been added. (page iva)
3. The List of Nomenclature has been updated. (Page v)
4. The Introduction has been updated. (Page 1)

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CHANGE SHEET

For

NASA-MSC Internal Note 68-FM-45, dated February 16, 1968

Mission A-2/CSM 020 (Apollo 6)

Separation and Recontact

Analysis

Summary Document

By Mission Simulation Department
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2. The List of Illustrations has been updated. (page iva)
3. The List of Nomenclature has been updated. (Page v)
4. The Introduction has been updated. (Page 1)

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05952-H415-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO 57

LM SOIL EROSION STUDIES
FINAL REPORT

NAS 9-4810

31 JANUARY 1968

Prepared for
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PROJECT TECHNICAL REPORT

TASK E-34C

THE RADAR EQUATION AND THE REFLECTIVITY

NAS 9-4810

16 FEBRUARY 1968

Prepared for

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PROJECT TECHNICAL REPORT
TASK E-45A

THIRD SUMMARY REPORT

NAS 9-4810

11 MARCH 1968

Prepared for
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TRW NOTE NO. 68-FMT-608

PROJECT APOLLO
TASK MSC/TRW A-134

SUMMARY REPORT OF TRACKING SHIP POSITIONING DATA FOR COVERAGE OF TRANSLUNAR INJECTION MANEUVERS, 1969

6 MARCH 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW NOTE NO. 68-FMT-622

PROJECT APOLLO
TASK MSC/TRW A-117.2

DETAILED EVALUATION OF LUNAR LAUNCH WINDOW CONFIGURATIONS FOR MARCH 1969

20 FEBRUARY 1968

Prepared for
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TRW NOTE NO. 68-FMT-623

PROJECT APOLLO
TASK MSC/TRW A-77

AN EMPIRICAL SIMULATION OF THE TRANSLUNAR INJECTION BURN FOR THE NOMINAL AND HYBRID MISSION ENERGY RANGE

26 FEBRUARY 1968

Prepared for
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05952-H431-R0-00

APOLLO SPACECRAFT RADIATION PERFORMANCE ANALYSIS TASK E-65 TECHNICAL REPORT

MATHEMATICAL MODEL FOR VHF ANTENNA COVERAGE ANALYSIS OF APOLLO MISSIONS D AND E

---

27 FEBRUARY 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW
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05952-H434-R0-00

TRW NOTE NO. 68-FMT-626

PROJECT APOLLO

TASK MSC/TRW AA-24

ORBITAL DEPARTURE AND LAUNCH WINDOW ANALYSIS FOR MANNED MARS CONJUNCTION-CLASS MISSIONS, 1977-1983

22 MARCH 1968

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05952-H434-R0-00

TRW NOTE NO. 68-FMT-627

PROJECT APOLLO

TASK MSC/TRW A-134

LUNAR MISSION EARTH PARKING ORBIT COMMUNICATIONS ANALYSIS

1 APRIL 1968

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TRW Systems Group

Prepared for
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MANNED SPACECRAFT CENTER

05952-H413-R0-00

Cy 3

TRW NOTE NO. 68-FMT-620

PROJECT APOLLO

TASK MSC/TRW A-98

REAL-TIME PROGRAM VERIFICATION OF THE APOLLO MISSION C REENTRY GUIDANCE EQUATIONS

13 MARCH 1968

Prepared by
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TRW NOTE NO. 68-FMT-618

PROJECT APOLLO

TASKS MSC/TRW A-105, A-164

SIMULATIONS OF LUNAR LANDMARK NAVIGATION

19 MARCH 1968

Prepared for
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NAS 9-4810

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05952-H437-R0-00

PROJECT TECHNICAL REPORT
TASK E&DD E-67

TRW SESL CHAMBER A THERMAL ENVIRONMENT/2TV-1 SPACECRAFT COMPUTER PROGRAM VOLUME I ENGINEERING DESCRIPTION

NAS 9-4810

15 FEBRUARY 1968

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05952-H438-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8-T-011

MARCH 6, 1968

APOLLO MISSION TECHNIQUES
MISSION C (AS-205/CSM-101)
RETROFIRE AND REENTRY

VOLUME I

TECHNIQUES DESCRIPTION

APOLLO SPACECRAFT PROGRAM OFFICE
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05952-H438-R0-91

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

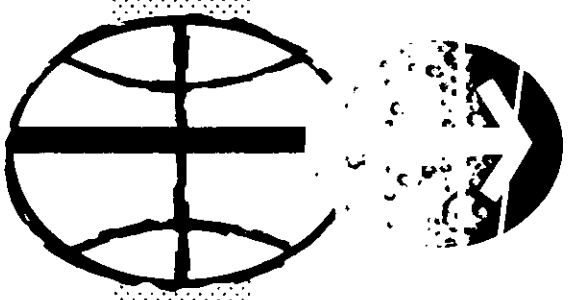
MSC INTERNAL NOTE NO. S-PA-8T-011

September 6, 1968

APOLLO MISSION TECHNIQUES
MISSION C
RETROFIRE AND REENTRY

VOLUME 1
TECHNIQUES DESCRIPTION

REVISION A



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BELL AEROSYSTEMS AND ROCKETDYNE
FACILITY INSTRUMENTATION AND PROCEDURES REVIEW

NAS 9-4810

6 March 1968

Prepared By

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D. W. Vernon, TRW Systems Group

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05952-H445-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-81

March 18, 1968

THE REAL-TIME AUXILIARY COMPUTING FACILITY APOLLO 6 (A-2/CSM-020) OPERATIONAL SUPPORT TEAM HANDBOOK

By Flight Analysis Branch
NASA/MSC
and
Mission Operations Section
TRW Systems Group

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MSC Subtask Monitor
S. D. Holzaepfel

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APOLLO CREW VISIBILITY SYSTEM
REQUIREMENTS AND STATUS

TASK ASPO 68

Contract No. NAS 9-4810

05952-H446-R000 6 March 1968

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TRW NOTE NO. 68-FMT-628

PROJECT APOLLO
TASK MSC/TRW A-139

AN ANALYSIS OF THE EFFECT OF A SPACECRAFT COLD SOAK CONSTRAINT ON ABORT SOLUTIONS

26 MARCH 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NAS 9-4810

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05952-H450-R0-00

TRW NOTE NO. 68-FMT-629

PROJECT APOLLO
TASK MSC/TRW A-162

APOLLO SATURN IB EARTH LAUNCH PHASE ABORT STUDY

MAY 1968

Prepared for
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05952-H452-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 MARCH 1968

Prepared for
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APOLLO COMMUNICATION SYSTEMS
TASK E-53B
TECHNICAL REPORT

TRACKING EFFECT DUE TO IAM ON THE UPLINK MODE CONTAINING BOTH S-BAND SUBCARRIERS

15 March 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Under

Contract No. NAS 9-4810

TRW
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TRW NOTE NO. 68-FMT-614

PROJECT APOLLO
TASK MSC/TRW A-136

PROC PROGRAMMING DESCRIPTION

30 APRIL 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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2142-6004-R0-000

PROJECT TECHNICAL REPORT

TASK NO. ASPO-12 (STAGING SUBTASK)

INTERIM REPORT ON STAGING ANALYSES

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810
ASSAP

21 April 1966

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PROGRAM TECHNICAL REPORT
TASK ASPO 22A

REVIEW OF SOIL EROSION PROBLEMS RELATED TO LEM LUNAR LANDING

NAS 9-4810

3 JUNE 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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2143-6002-R0000

FINAL REPORT

APOLLO LANDING PROBABILITY STUDY

CONTRACT NO. NAS9-4810 TASK 22

31 MAY 1966

TRW SYSTEMS

NARA SW Box E209H-6

FINAL REPORT

MULTILAYER CIRCUIT BOARD EVALUATION

Robert W. Korb

2191-6003-T0000

DECEMBER 22, 1965

Contract NAS9-4810

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2191-6005-T0000

PROJECT TECHNICAL REPORT
TASK ASPO 5

PRESENTATION ON APOLLO BACKUP GUIDANCE FOR SATURN

Prepared for

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March 1966

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2191-6006-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO 5~~4~~

PULSE TORQUE ASSEMBLY THERMAL ANALYSIS

5 APRIL 1966

Prepared for:
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

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ANALYSIS OF PRELIMINARY MIT DESIGN FOR CSM-RCS DIGITAL AUTOPILOT

(Task ASPO 15.4)

2141-6009-TU000

8 November 1965

TRW SPACE TECHNOLOGY LABORATORIES

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Trip Report for the November 22 and 23, 1965 Meetings on the CSM RCS and TVC Digital Autopilot Designs (Task ASPO 15.4)

2141-6012-T0000

9 December 1965

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LUNAR SURFACE VISIBILITY STUDIES: STATUS AND EVALUATION

by

D. P. Ahearne, Jr.
K. Ziedman

21 January 1966

2143 H002 RU000

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AND STRESS ANALYSIS

ASPO Task No. 5

24 January 1966

Report No. 2191-6004-R0000 Contract No. NAS 9-4810

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2142-6003-T0-000

PROGRAM TECHNICAL REPORT
TASK ASPO 12

ADDITIONAL BLOCK II CSM ATTITUDE CONTROL MODE BLOCK DIAGRAMS FOR LUNAR PERFORMANCE VALIDATION

NAS 9-4810

1 APRIL 1966

Prepared for
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05952-H458-R0-00

PROJECT TECHNICAL REPORT

FINAL ANALYSIS OF THE DESCENT PROPULSION SYSTEM DURING THE FLIGHT OF APOLLO 5

NAS 9-4810

22 March 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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PROJECT TECHNICAL REPORT
TASK E-45A

DATA SELECTION PROGRAM
HH017A

NAS 9-4810

25 MARCH 1968

Prepared for
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05952-H461-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-103

APRIL 19, 1968

APOLLO MISSION D-a/CSM-103/LM-3 REVISED SPACECRAFT REFERENCE TRAJECTORY VOLUME I

BY ORBITAL ANALYSIS SECTION
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

PRELIMINARY REPORT

TASK E-34C

NAS 9-4810 22 MARCH 1968

PRELIMINARY ANALYSIS
of
LANDING RADAR FREQUENCY TRACKER

Prepared for

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TECHNICAL REPORT
TASK E-34C

NAS9-4810 1 APRIL 1968

C-BAND RADAR CROSS SECTION FOR SPACECRAFT 101

Prepared for
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TRW NOTE NO. 68-FMT-635

PROJECT APOLLO
TASK MSC/TRW A-152

ANALYSIS OF THE APOLLO ENTRY GUIDANCE EQUATIONS FOR COLOSSUS

16 APRIL 1968

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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05952-H466-R0-00

PROJECT TECHNICAL REPORT
TASK E&D-38

APOLLO V GUIDANCE AND NAVIGATION ERROR ANALYSIS - FINAL REPORT

NAS 9-4810

27 MARCH 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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05952-H467-R0-00

PROJECT TECHNICAL REPORT
TASK E-45A

AS-502 PREFLIGHT HEAT SHIELD PERFORMANCE PREDICTIONS

NAS 9-4810

27 MARCH 1968

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TRW NOTE NO. 68-FMT-634

PROJECT APOLLO
TASK MSC/TRW A-157

LAUNCH VEHICLE SIMULATION PROGRAM REPORT
PHASE I
VOLUME I

19 APRIL 1968

Prepared for
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05952-H470-R0-00

PROJECT TECHNICAL REPORT
TASK E-38

APOLLO 6
GN&C PREFLIGHT PERFORMANCE REVIEW

NAS 9-4810

29 MARCH 1968

Prepared for
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05952-H471-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-108

cy1

April 15, 1968

APOLLO MISSION D: AS-503/CSM-103/LM-3 SPACECRAFT PRELIMINARY ALTERNATE MISSION STUDIES

By Mission Analysis Laboratory
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MSC Task Monitors
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APOLLO SPACECRAFT SYSTEM ANALYSIS PROGRAM
TASK E-34C

TECHNICAL REPORT

RENDEZVOUS RADAR EARTH ORBITAL FLIGHT TEST FEASIBILITY STUDY

---

2 APRIL 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Under
Contract No. NAS 9-4810

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TRW NOTE NO. 68-FMT-640

PROJECT APOLLO
TASK MSC/TRW A-126

LM POWERED DESCENT MONITORING DISPLAYS

19 APRIL 1968

Prepared for
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05952-H474-R0-00

PROJECT TECHNICAL REPORT
TASK E-45A

DATA SMOOTHING PROGRAM
HH018A

NAS 9-4810

28 MARCH 1968

Prepared for
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APOLLO COMMUNICATION SYSTEMS
TASK E-59A
TECHNICAL REPORT

LM-3 TELEMETRY SYSTEM PERFORMANCE
BIT TRANSITION DENSITY REPORT

---

8 April 1968

Prepared for

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Contract No. NAS 9-4810

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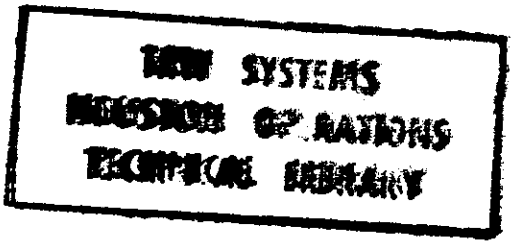
TRW NOTE NO. 68-FMT-641

PROJECT APOLLO

TASK MSC/TRW AA-20

FEASIBILITY OF POSTLAUNCH DEBRIS IMPACT PREDICTIONS BY USING NORAD REENTRY DATA

11 APRIL 1968



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05952-H477-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 68-FM-90

March 27, 1968

REENTRY POSTFLIGHT TRAJECTORY RECONSTRUCTION AND GUIDANCE EVALUATION FOR AS-501 (CSM-017)

By Flight Analysis Section,
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05952-H478-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 APRIL 1968

Prepared for
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05952-H482-R0-91

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. EB-R-68-12

August 21, 1968

APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION APOLLO 7 REVISION I

By Communications Systems Section
TRW Systems Group

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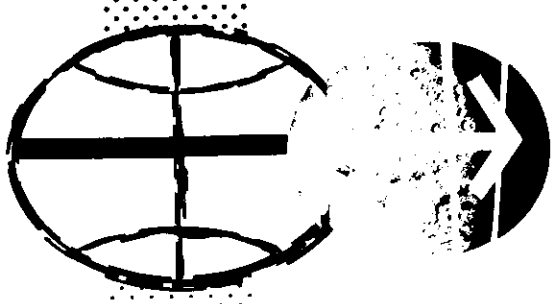

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05952-H469-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TECHNICAL REPORT
TASK E-34C-1

NAS9-4810

28 MARCH 1968

INSTRUMENTATION SYSTEM FOR TRACKER ANALYSIS STUDY

Prepared for
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05952-H482-R0-01

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. EB-R-68-12

September 30, 1968

VOLUME II

ADDENDUM APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION APOLLO 7 REVISION I

By Communications Systems Section
TRW Systems Group

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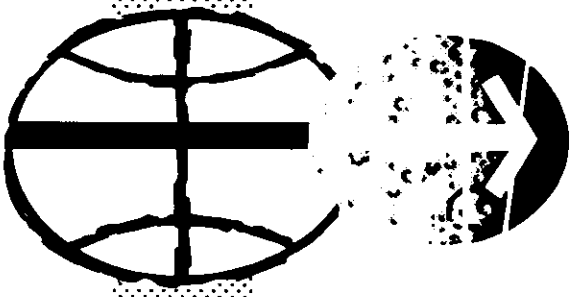

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1D4 /A. Cohen

05952-H483-R0-00

TRW NOTE NO. 68-FMT-639

PROJECT APOLLO

TASK MSC/TRW A-168

ANALYSIS OF APOLLO COMMAND AND SERVICE MODULE ENVIRONMENTAL CONTROL SYSTEM SECONDARY LOOP RADIATOR SYSTEM AND PROGRAM NO. HH021A USER'S MANUAL

15 MAY 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 68-FMT-642

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO MISSION 5/AS-204/LM-1 TRAJECTORY RECONSTRUCTION AND POSTFLIGHT ANALYSIS - APPENDIXES

VOLUME I

22 APRIL 1968

Prepared for
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TRW NOTE NO. 68-FMT-637

PROJECT APOLLO
TASK MSC/TRW A-157

LAUNCH VEHICLE SIMULATION PROGRAM REPORT
PHASE I
VOLUME II

19 APRIL 1968

Prepared for
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05952-H486-R0-00

APOLLO COMMUNICATION SYSTEMS
TASK E-59A
TECHNICAL REPORT

LTA-8 S-BAND EQUIPMENT TEMPERATURE MEASUREMENT LOCATIONS REPORT

---

15 APRIL 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

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TRW NOTE NO. 68-FMT-646

PROJECT APOLLO
TASK MSC/TRW A-100

DESCRIPTION OF APROC ADAPTIVE STATISTICAL PROCESSOR PROGRAM

29 APRIL 1968

Prepared for
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MSC INTERNAL NOTE NO. EB-R-68-12

ADDENDUM
APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION APOLLO 7 REVISION 1, VOLUME I

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and
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05952-H491-R0-00

pp 3 2

TRW NOTE NO. 68-FMT-650

PROJECT APOLLO

TASK MSC/TRW A-166

ENGINEERS MANUAL
COMMAND SERVICE MODULE ELECTRICAL POWER SYSTEM
PROGRAM HX001A

6 MAY 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 68-FMT-648

PROJECT APOLLO
TASK MSC/TRW A-116.5

APOLLO FORCED ENTRY DEBRIS DISPERSION STUDY

25 APRIL 1968

Prepared for
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TRW NOTE NO. 68-FMT-630

PROJECT APOLLO
TASK MSC/TRW A-139

APOLLO LUNAR LANDING MISSION DELTA-VELOCITY BUDGET STUDY FOR EARTH-PHASE POSTABORT MIDCOURSE MANEUVERS

24 APRIL 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 68-FMT-643

PROJECT APOLLO
TASK MSC/TRW A-163

APOLLO CMC/LGC SOFTWARE DEVELOPMENT PLAN

30 APRIL 1968

Prepared for
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TRW NOTE NO. 68-FMT-644

PROJECT APOLLO
TASK MSC/TRW A-163

APOLLO CMC/LGC SOFTWARE READINESS VERIFICATION PLAN

30 APRIL 1968

Prepared for
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TRW NOTE NO. 68-FMT-645

PROJECT APOLLO
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APOLLO CMC/LGC SOFTWARE MANAGEMENT PLAN

30 APRIL 1968

Prepared for
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05952-H497-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-46

DATA ACCEPTANCE LIMITS

NAS 9-4810

31 MAY 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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05952-H498-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 MAY 1968

Prepared for
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05952-H500-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8-T-011

MAY 17 , 1968

APOLLO MISSION TECHNIQUES
MISSION C (AS-205/CSM-101)
RETROFIRE AND REENTRY

VOLUME II

DATA ACCEPTANCE LIMITS
ANALYSIS PLANS

*70-28127

APOLLO SPACECRAFT PROGRAM OFFICE
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HOUSTON, TEXAS

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TRW NOTE NO. 68-FMT-652

PROJECT APOLLO
TASK MSC/TRW A-117.1

LUNAR LAUNCH WINDOW CONFIGURATION JANUARY 1970 - JUNE 1970

28 MAY 1968

Prepared for
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05952-H503-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK E-34C-1

A TECHNIQUE FOR COMPUTING TERRAIN EFFECTS ON RADAR RETURN

NAS 9-4810

14 May 1968

Prepared for
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APOLLO COMMUNICATION SYSTEM ANALYSIS
TASK E-9D
TECHNICAL REPORT

ANALYSIS OF POSSIBLE LUNAR-MULTIPATH DEGRADATION OF LM BACKUP MODES USING LM S-BAND OMNIDIRECTIONAL ANTENNAS

---

20 MAY 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Under
Contract No. NAS 9-4810

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TASK E-34C-1

COMPARISON OF SURVEYOR DATA WITH BECKMANN-SMITH REFLECTIVITY MODEL

NAS9-4810 15 May 1968

Prepared for

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APOLLO COMMUNICATION SYSTEMS
TASK E-59A
TECHNICAL REPORT

OPTIMIZATION OF EQUIVALENT NOISE BANDWIDTH MEASUREMENTS

20 May 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Under

Contract No. NAS 9-4810

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05952-H510-R0-00

LM AND CSM S-BAND ANTENNA TRACKING STUDIES
TASK E-53B
TECHNICAL REPORT

DYNAMIC STUDIES OF LM S-BAND ANTENNA TRACKING SYSTEM (PRELIMINARY REPORT)

---

17 MAY 1968

Prepared for

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HOUSTON, TEXAS

Under

Contract No. NAS 9-4810

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05952-H512-R0-00

GENERAL TASK PLAN
TASK E-74

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-4810

17 MAY 1968

Prepared for
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TRW NOTE NO. 68-FMT-647

PROJECT APOLLO
TASK MSC/TRW A-100

ENGINEERING DESCRIPTION OF TAPP VIA

13 JUNE 1968

Prepared for
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TRW NOTE NO. 68-FMT-651

PROJECT APOLLO
TASK MSC/TRW A-152

A-2/CSM 020 (APOLLO 6) REENTRY MISSION PLAN

31 MAY 1968

Prepared for
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05952-H516-R0-00

PROJECT TECHNICAL REPORT

TASK E&DD E-67

TRW SESL CHAMBER A THERMAL ENVIRONMENT/2TV-1 SPACECRAFT COMPUTER PROGRAM VOLUME II PROGRAM NUMBER HH022A USERS MANUAL

NAS 9-4810

April 30, 1968

Prepared for
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TRW NOTE NO. 68-FMT-658

PROJECT APOLLO
TASK MSC/TRW A-184

LAUNCH WINDOW SUMMARY, GEOGRAPHIC LOCI OF APOLLO TRANSLUNAR INJECTION BURNS, AND FREE RETURN TOUCHDOWN POSITIONS FOR JANUARY - JUNE 1970

24 JUNE 1968

Prepared for
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TRW NOTE NO. 68-FMT-659

PROJECT APOLLO
TASK MSC/TRW A-156

A MANUAL ABORT TECHNIQUE FOR ABORTS FROM POWERED DESCENT

31 MAY 1968

Prepared for
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05952-H525-R0-00

PROJECT TECHNICAL REPORT
TASK E-45A

APOLLO MISSION AS-502
HEAT SHIELD THERMOCOUPLE DATA

NAS 9-4810

29 MAY 1968

Prepared for
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05952-H526-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

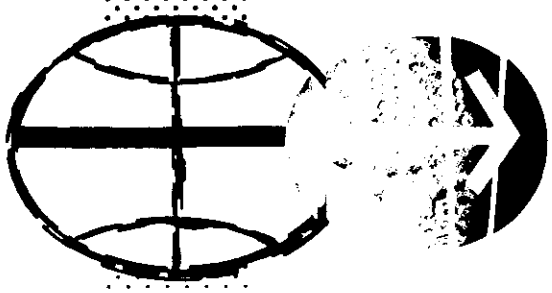
MSC INTERNAL NOTE NO. S-PA-8T-016

MAY 29, 1968

APOLLO MISSION TECHNIQUES
MISSION C (AS-205/CSM - 101)
CSM RENDEZVOUS

VOLUME 1

TECHNIQUES DESCRIPTION



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05952-H526-R0-01

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8T-016

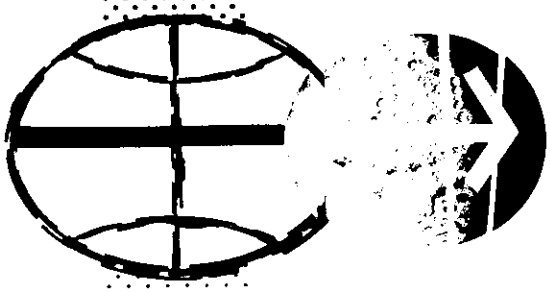
AUGUST 12, 1968

APOLLO MISSION TECHNIQUES
MISSION C
CSM RENDEZVOUS

VOLUME 1

TECHNIQUES DESCRIPTION

REVISION A



APOLLO SPACECRAFT PROGRAM OFFICE
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TRW NOTE NO. 68-FMT-662

PROJECT APOLLO
TASK MSC/TRW A-196.1

THE LUNAR OBSERVATIONS VERIFIER EDITOR IMPLEMENTATION PLAN

26 JULY 1968

Prepared for
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05952-531-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 JUNE 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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TRW NOTE NO. 68-FMT-654

PROJECT APOLLO
TASK MSC/TRW A-157

AN INVESTIGATION OF S-IB ABORT CRITERIA BASED ON BOOSTER PERFORMANCE CAPABILITIES

28 MAY 1968

Prepared for
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TRW NOTE NO. 68-FMT-660

PROJECT APOLLO
TASK MSC/TRW A-174

SUNDANCE TEST PLAN IN SUPPORT OF THE APOLLO MISSION D FLIGHT SOFTWARE VERIFICATION

12 JUNE 1968

Prepared for
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05952-H538-RO-00

APOLLO COMMUNICATION SYSTEMS
TASK E-59A
TECHNICAL REPORT

LM-4 TELEMETRY SYSTEM PERFORMANCE BIT TRANSITION DENSITY REPORT

17 July 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

Under
Contract No. NAS 9-4810

TRW SYSTEMS

NARA SW Box E209H-75

05952-H545-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

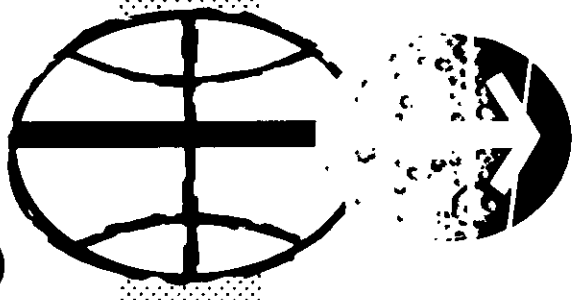
MSC INTERNAL NOTE NO. S-PA-8-T-016

July 15, 1968

APOLLO MISSION TECHNIQUES
MISSION C (AS-205/CSM - 101)
CSM RENDEZVOUS

VOLUME II

DATA ACCEPTANCE LIMITS
ANALYSIS PLANS



APOLLO SPACECRAFT PROGRAM OFFICE
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05952-H546-R0-00

PROJECT TECHNICAL REPORT

TASK E&D-38

APOLLO VI GUIDANCE AND NAVIGATION ERROR ANALYSIS - FINAL REPORT

NAS 9-4810

28 JUNE 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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SYSTEMS GROUP

NARA SW Box E209H-75

LM AND CSM S-BAND ANTENNA TRACKING STUDIES
TASK E-53C
TECHNICAL REPORT

LM AND CSM S-BAND ANTENNA TRACKING
PROGRESS REPORT
(FOR FISCAL YEAR ENDING 28 JUNE 1968)

---

28 JUNE 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-4810

TRW
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TRW NOTE NO. 68-FMT-668

PROJECT APOLLO
TASK MSC/TRW A-140

PRELIMINARY ONBOARD BACKUP ABORT PROCEDURES LUNAR ORBIT INSERTION PHASE

29 JULY 1968

Prepared for
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TRW NOTE NO. 68-FMT-669

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO MISSION 6, AS-502 TRAJECTORY RECONSTRUCTION AND POSTFLIGHT ANALYSIS - VOLUME I

15 JULY 1968

Prepared for
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NAS 9-4810

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05952-H552-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8T-018

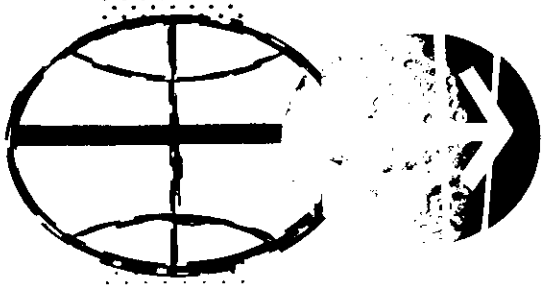
July 19, 1968

APOLLO MISSION TECHNIQUES

APOLLO 7

LAUNCH PHASE ABORTS

TECHNIQUES DESCRIPTION



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05952-H553-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-4810

15 JULY 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
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05952-H554-R0-00

GAEC DATA ACQUISITION PLAN

TASK E-74

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

11 JULY 1968

Prepared for
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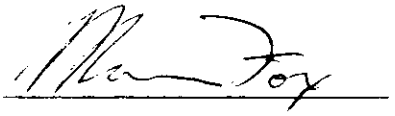
Approved by 

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05952-H557-R0-00

LM-5 PARAMETER SENSITIVITY ANALYSIS PLAN
MISSION "F"

TASK E-74

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-4810

12 JULY 1968

Prepared for
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05952-H557-R0-00

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05952-H560-RO-00

LM-3 DATA ANALYSIS PLAN

MISSION "D"

TASK E-74

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-4810 17 JULY 1968

Prepared for
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05952-H532-R0-00

PROJECT TECHNICAL REPORT

TASK E&DD E-45A

STAB II CHARRING ABLATION COMPUTER PROGRAM

PROGRAM NUMBER HH020A USERS MANUAL

NAS 9-4810

JUNE 15, 1968

Prepared for
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TRW NOTE NO. 68-FMT-670

PROJECT APOLLO
TASK MSC/TRW A-196

RESULTS OF AN INITIAL ANALYSIS TO DETERMINE MSFN ACCURACY IN TRACKING A LUNAR ORBITING VEHICLE

26 AUGUST 1968

Prepared for
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MSC INTERNAL NOTE NO. 68-FM-206

AUGUST 15, 1968

APOLLO 7 CSM/S-IVB LAUNCH ABORT SEPARATION AND RECONTACT ANALYSIS

*70-28123

By Mission Simulation Department
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and
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TRW NOTE NO. 68-FMT- 680

PROJECT APOLLO
TASK MSC/TRW AA-25

GUIDANCE/TARGETING ANALYSIS AND DEVELOPMENT FOR APOLLO APPLICATIONS PROGRAM

19 AUGUST 1968

Prepared for
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TRW NOTE NO. 68-FMT-681

APOLLO APPLICATIONS
TASK MSC/TRW AA-27

AN INVESTIGATION OF EXPERIMENTS SCHEDULING FOR AAP MISSIONS

1 SEPTEMBER 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 68-FMT-684

PROJECT APOLLO
TASK MSC/TRW A-167

IMPLEMENTATION PLAN FOR THE LM RCS CONSUMABLES PROGRAM

30 AUGUST 1968

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SEP 2 1 1968

05952-H591-R0-00

TRW NOTE NO. 68-FMT-689

PROJECT APOLLO
TASK MSC/TRW AA-27

PRELIMINARY IMPLEMENTATION DETAILS OF THE PROPOSED EXPERIMENTS SCHEDULING PROGRAM

25 SEPTEMBER 1968

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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PERFORMANCE ASSESSMENT OF APOLLO RADAR SYSTEMS
TASK E-34D
TECHNICAL REPORT

RENDEZVOUS RADAR EARTH ORBITAL
FLIGHT TEST PLAN

15 JULY 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

Under

Contract No. NAS 9-8166

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TRW NOTE NO. 66 FMT-238

PROJECT APOLLO
TASK MSC/TRW A-102

ANALYTIC INTERPLANETARY PROGRAM
VOLUME III, ENGINEERING MANUAL

2 DECEMBER 1966

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 9A
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

05952-6007-T000 15 July 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas
Under
Contract No. NAS9-4810

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TRW NOTE NO. 66 FMT-239

PROJECT APOLLO
TASK MSC/TRW A-4

DESCRIPTION OF FINAL RANGE SAFETY PACKAGE FOR MISSION AS-202

1 AUGUST 1966

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 66 FMT-241

PROJECT APOLLO
TASK MSC/TRW A-60.4

INTERIM REPORT FOR LUNAR LANDING MISSIONS ABORT ANALYSES

15 AUGUST 1966

Prepared for
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PROJECT TECHNICAL REPORT
TASK ASPO 36

DETERMINATION OF A YAW PLANE GUIDANCE MODEL FOR CSM THRUST VECTOR CONTROL SYSTEM STUDIES

NAS 9-4810

3 AUGUST 1966

Prepared for
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LUNAR SURFACE VISIBILITY

05952-6011-R000 August 3, 1966

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This report was prepared for Manned Spacecraft Center under NASA MSC Task 22, Contract Number NAS 94810.

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05952-6014-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK ASPO 20

APOLLO EMERGENCY DETECTION SYSTEM SIDE ACCELERATION EQUATIONS

NAS 9-4810

July 1966

Prepared for
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05952-6015-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-36

PRELIMINARY ANALYSIS OF THE MISSION AS-278A CSM THRUST VECTOR CONTROL SYSTEM

NAS 9-4810

9 AUGUST 1966

Prepared for
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TRW NOTE NO. 66 FMT-242

PROJECT APOLLO
TASK MSC/TRW A-66

ADDENDUM 1 TO PARAMETRIC STUDY TO DEFINE THE APOLLO ENTRY CORRIDOR

29 AUGUST 1966

Prepared for
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05952-6016-R002

TRW NOTE NO. 66 FMT-243

PROJECT APOLLO
TASK MSC/TRW A-66

SUPPLEMENT TO ADDENDUM 1 TO PARAMETRIC STUDY TO DEFINE THE APOLLO ENTRY CORRIDOR

29 AUGUST 1966

Prepared for
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05952-6001-R000

PROJECT TECHNICAL REPORT
TASK ASPO 5A

PLUME-SURFACE INTERACTION ANALYSIS

NAS 9-4810

22 July 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-77

TRW NOTE NO. 66 FMT-245

PROJECT APOLLO
TASK MSC/TRW A-81.3

GUIDANCE TARGET UPDATE AND DISPERSION ANALYSIS FOR APOLLO LUNAR OPERATIONS

23 SEPTEMBER 1966

Prepared for
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05952-6028-R001

TRW NOTE NO. 66 FMT-246

PROJECT APOLLO
TASK MSC/TRW A-93

OPERATING INSTRUCTIONS FOR INTEGRATING MONTE CARLO PROGRAM AND STATISTICAL PROCESSOR

22 SEPTEMBER 1966

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 66 FMT-246

PROJECT APOLLO
TASK MSC/TRW A-93

OPERATING INSTRUCTIONS FOR INTEGRATING MONTE CARLO PROGRAM AND STATISTICAL PROCESSOR

22 SEPTEMBER 1966

Prepared for
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TRW NOTE NO. 66 FMT-248

PROJECT APOLLO
TASK MSC/TRW A-91

ERROR ANALYSIS FOR CSM RESCUE OF LM FOR ASSESSMENT OF CSM-RCS FUEL REQUIREMENTS

26 SEPTEMBER 1966

Prepared for
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05952-6030-R001

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TRW NOTE NO. 66 FMT-247

PROJECT APOLLO
TASK MSC/TRW A-60.2

THIRD INTERIM REPORT FOR LUNAR LANDING MISSIONS EARTH PHASE ABORT ANALYSES

15 SEPTEMBER 1966

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 66 FMT-247

PROJECT APOLLO
TASK MSC/TRW A-60.2

THIRD INTERIM REPORT FOR LUNAR LANDING MISSIONS EARTH PHASE ABORT ANALYSES

15 SEPTEMBER 1966

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 9B
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

05952-6033-T000 15 September 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas
Under
Contract No. NAS9-4810

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05952-6035-R000

PROGRAM TECHNICAL REPORT

TASK ASPO-17-(5)

DERIVATION OF ABLATOR THERMAL PROPERTIES FOR APOLLO COMMAND MODULE HEAT SHIELD MATERIAL

NAS 9-4810

15 SEPTEMBER 1966

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05952-6027-R001

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TRW NOTE NO. 66 FMT-245

PROJECT APOLLO
TASK MSC/TRW A-81.3

GUIDANCE TARGET UPDATE AND DISPERSION ANALYSIS FOR APOLLO LUNAR OPERATIONS

23 SEPTEMBER 1966

ABRIDGEMENT

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TRW NOTE NO. 66 FMT-249

PROJECT APOLLO
TASK MSC/TRW A-48

RESULTS OF PROCESSING SIMULATED DOPPLER RADAR DATA FOR LM ASCENT WITH THE APOLLO POWERED FLIGHT DATA PROCESSOR

30 SEPTEMBER 1966

A B R I D G E M E N T

Prepared for
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05952-6038-R000

TRW NOTE NO. 66 FMT-249

PROJECT APOLLO
TASK MSC/TRW A-48

RESULTS OF PROCESSING SIMULATED DOPPLER RADAR DATA FOR LM ASCENT WITH THE APOLLO POWERED FLIGHT DATA PROCESSOR

30 SEPTEMBER 1966

Prepared for
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05952-6047-R000

TRW NOTE NO. 66 FMT-250

PROJECT APOLLO
TASK MSC/TRW A-81.1

APOLLO LUNAR OPERATIONS FROM OFF-NOMINAL CSM LUNAR PARKING ORBITS

31 OCTOBER 1966

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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05952-6049-R001

TRW NOTE NO. 66 FMT-251

PROJECT APOLLO
TASK MSC/TRW A-3

MISSION AS-204 CM/SM SEPARATION PRIOR TO REENTRY

10 OCTOBER 1966

ABRIDGEMENT

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TRW NOTE NO. 66 FMT-251

PROJECT APOLLO
TASK MSC/TRW A-3

MISSION AS-204 CM/SM SEPARATION PRIOR TO REENTRY

10 OCTOBER 1966

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TRW NOTE NO. 66 FMT-252

PROJECT APOLLO
TASK MSC/TRW A-4

PRELIMINARY EVALUATION OF THE ALSEP FUEL CASK SURVIVABILITY AND EARTH IMPACT FOR APOLLO MISSION 504

11 OCTOBER 1966

Prepared for
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05952-6055-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO - 36

ANALYSIS OF PROPELLANT SLOSHING STABILITY DURING CSM THRUST VECTOR CONTROL SYSTEM OPERATIONS

NAS 9-4810

18 OCTOBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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VELLUM

05952-6056-R000

PROJECT TECHNICAL REPORT

TASK ASPO 22A

AN INVESTIGATION OF SOIL EROSION AND ITS POTENTIAL HAZARD TO LM LUNAR LANDING

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

1 October 1966

TRW SYSTEMS
AN OPERATING GROUP OF TRW INC

NARA SW Box E209H-79

TRW NOTE NO. 66 FMT-253

PROJECT APOLLO
TASK MSC/TRW A-86

FINAL REPORT ON PARAMETRIC STUDIES OF ENTRY TARGETING CRITERIA FOR MISSION AS-204

12 DECEMBER 1966

Prepared for
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05952-6059-R0-00

Addendum to TRW Systems Report 05952-6010-R0-00 "Determination of a Yaw Plane Guidance Model for CSM Thrust Vector Control System Studies

NAS 9-4810

18 October 1966

Prepared for
National Aeronautics and Space Administration
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05952-6037-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO - 36A

DESCRIPTION OF LUNAR MODULE DIGITAL AUTOPILOT FOR HYBRID SIMULATION STUDIES

NAS 9-4810

29 SEPTEMBER 1966

Prepared for
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6-10-10

TRW SYSTEMS

NARA SW Box E209H-79

PRELIMINARY EVALUATION OF A SCHEME USING IMU DATA TO COMPUTE BOOST-PHASE SIDE LOADS

TRW SPACE TECHNOLOGY LABORATORIES

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ONE SPACE PARK • REDONDO BEACH, CALIFORNIA

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PRELIMINARY EQUATIONS FOR THE EMERGENCY DETECTION OF LAUNCH VEHICLE SIDE ACCELERATIONS FROM THE APOLLO GUIDANCE SYSTEM

ASSAP Task 20

TRW No. 2222-6005-TO000 November 1965

TRW SYSTEMS
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2222-6010-TO-000

AS-206 GUIDANCE AND NAVIGATION

OPERATIONAL REQUIREMENTS

24 January 1966

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A GUIDANCE SCHEME

FOR POWERED LUNAR DESCENT

WITH CONSTANT THRUST

TASK ASPO 20

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2222-6012-T0000
NAS 9-4810
25 March 1966
Total Pages 62

APOLLO MISSION 202
GUIDED ENTRY FOOTPRINT AS A FUNCTION OF AERODYNAMIC LIFT-TO-DRAG RATIO

ASSAP TASK 20

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J. W. Shively

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PROJECT TECHNICAL REPORT
TASK ASPO 20

APOLLO GUIDANCE SOFTWARE

CHANGE PROCEDURE

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NAS 9-4810

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AS 202 FLIGHT SOFTWARE
QUALIFICATION TEST PLAN

1 December 1965

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AS-501 GUIDANCE AND NAVIGATION OPERATIONAL SOFTWARE REQUIREMENTS

15 December 1965

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Contract NAS 9-4810
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AS-201 STABILIZATION AND CONTROL SYSTEM PREFLIGHT TEST PROGRAM EVALUATION AND FLIGHT TEST ANALYSIS PLAN TASK ASPO 26

NAS 9-4810

9 February 1966

Prepared For
National Aeronautics and Space Administration
Manned Spacecraft Center

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2223-H002-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO-26

THERMAL VACUUM SPACECRAFT 008 DATA REDUCTION AND ANALYSIS PLAN

NAS 9-4810 15 MAY 1966

Prepared for
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2223-H003-R0-000

PROJECT TECHNICAL REPORT
TASK ASPO-26

AS-202 GUIDANCE NAVIGATION AND CONTROL SYSTEM FLIGHT TEST ANALYSIS PLAN

NAS 9-4810 30 JUNE 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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APOLLO GN & C
GROUND TEST PROGRAM
SUMMARY

December 1965

Document No. 2223-6001-R0000

Prepared for
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Under Contract No. NAS 9-4810
ASPO Task 26

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SATURN BACKUP GUIDANCE
SIMULATION PLAN

ASPO Task No. 20

18 October 1965

Report No: 2222-6002-TU000 Contract No. NAS 9-4810

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TRW NOTE NO. 66 FMT-257

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO AS-202 TRAJECTORY RECONSTRUCTION
VOLUME I: ANALYSIS

15 NOVEMBER 1966

Prepared for
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TRW NOTE NO. 66 FMT-258

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO AS-202 TRAJECTORY RECONSTRUCTION
VOLUME II: TRAJECTORY LISTING

15 NOVEMBER 1966

Prepared for
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TRW NOTE NO. 66 FMT-259

PROJECT APOLLO
TASK MSC/TRW A-3

PROBABILITY OF S-IVB AND CSM RECONTACT FROM SEPARATION TO PERICYNTHION FOR MISSION AS-504A

25 NOVEMBER 1966

ABRIDGEMENT

Prepared for
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25 NOVEMBER 1966

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TRW NOTE NO. 66 FMT-261

PROJECT APOLLO
TASK MSC/TRW A-3

EFFECT OF RCS FAILURES ON CM/SM SEPARATION DYNAMICS

30 NOVEMBER 1966

Prepared for
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TRW NOTE NO. 66 FMT-264

PROJECT APOLLO
TASK MSC/TRW A-116

ENTRY DEBRIS HAZARD EVALUATION FOR MISSION AS-204

4 JANUARY 1967

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05952-6078-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-36

DESIGN VERIFICATION AND PERFORMANCE EVALUATION OF THE LUNAR MODULE DIGITAL AUTOPILOT

NAS 9-4810

28 NOVEMBER 1966

VOLUME I
SUMMARY

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-80

JAN 23 1967

05952-6078-R001

PROJECT TECHNICAL REPORT
TASK ASPO-36

DESIGN VERIFICATION AND PERFORMANCE EVALUATION OF THE LUNAR MODULE DIGITAL AUTOPILOT

NAS 9-4810

28 NOVEMBER 1966

VOLUME II
UNPOWERED FLIGHT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-80

05952-6078-R002

PROJECT TECHNICAL REPORT
TASK ASPO-36

DESIGN VERIFICATION AND PERFORMANCE EVALUATION OF THE LUNAR MODULE DIGITAL AUTOPILOT

NAS 9-4810

28 NOVEMBER 1966

VOLUME III
POWERED DESCENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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TRW SYSTEMS

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~~Part 2~~
~~13 1 6~~

05952-6078-R003

2-1-6

PROJECT TECHNICAL REPORT
TASK ASPO-36

DESIGN VERIFICATION AND PERFORMANCE EVALUATION OF THE LUNAR MODULE DIGITAL AUTOPILOT

NAS 9-4810

28 NOVEMBER 1966

VOLUME IV
POWERED ASCENT

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-80

TRW NOTE NO. 66 FMT-265

PROJECT APOLLO
TASK MSC/TRW A-4

EFFECT OF LAUNCH VEHICLE DESTRUCT ACTION ON SM, LM ADAPTER, AND LM TEST ARTICLE FOR MISSION AS-501

8 DECEMBER 1966

ABRIDGEMENT

Prepared for
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05952-6082-R001

TRW NOTE NO. 66 FMT-269

PROJECT APOLLO
TASK MSC/TRW A-96

ABORT LIMIT LINES DUE TO SATURN IB AND APOLLO BLOCK I STRUCTURAL CONSTRAINTS

9 DECEMBER 1966

ABRIDGEMENT

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TASK MSC/TRW A-96

ABORT LIMIT LINES DUE TO SATURN IB AND APOLLO BLOCK I STRUCTURAL CONSTRAINTS

9 DECEMBER 1966

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PROJECT TECHNICAL REPORT
TASK ASPO-36

TWO AXIS EXTENSION OF PLANAR STABILITY ANALYSES FOR THE CSM THRUST VECTOR CONTROL SYSTEM

NAS 9-4810

25 NOVEMBER 1966

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW SYSTEMS

NARA SW Box E209H-80

TRW NOTE NO. 67 FMT-298

PROJECT APOLLO
TASK MSC/TRW A-116

TECHNIQUES FOR THE EVALUATION OF ENTRY DEBRIS HAZARDS

15 MAY 1967

Prepared for
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05952-6067-R001

TRW NOTE NO. 66 FMT-257

PROJECT APOLLO
TASK MSC/TRW A-50

APOLLO AS-202 TRAJECTORY RECONSTRUCTION
VOLUME I: ANALYSIS

15 NOVEMBER 1966

ABRIDGEMENT

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TRW NOTE NO. 67 FMT-272

PROJECT APOLLO
TASK MSC/TRW A-4

EFFECT OF LAUNCH VEHICLE DESTRUCT ACTION ON LM AND LM ADAPTER FOR MISSION AS-206

25 JANUARY 1967

Prepared for
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TRW NOTE NO. 67 FMT-276

PROJECT GEMINI
TASK MSC/TRW G-15

3401, 6-341

GEMINI 12 ORBIT AND REENTRY TRAJECTORY RECONSTRUCTION

23 JANUARY 1967

Prepared for
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05952-6106-R002

USER'S MANUAL FOR PATS

PROPULSION ANALYSIS TRAJECTORY SIMULATION program

1968 November 1

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05952-6112-R000

TRW NOTE NO. 67 FMT-277

PROJECT APOLLO
TASK MSC/TRW AA-9

EVALUATION OF CURRENT APOLLO SPACECRAFT RANGE SAFETY AND ORBITAL DEBRIS HAZARD ANALYSES FOR SUPPORT OF AAP MISSIONS

Prepared by
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6 FEBRUARY 1967

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05952-6112-R001

TRW NOTE NO. 67 FMT-277

PROJECT APOLLO
TASK MSC/TRW AA-9

EVALUATION OF CURRENT APOLLO SPACECRAFT RANGE SAFETY AND ORBITAL DEBRIS HAZARD ANALYSES FOR SUPPORT OF AAP MISSIONS

6 FEBRUARY 1967

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 67 FMT-278

PROJECT APOLLO
TASK MSC/TRW A-48

MATHEMATICAL MODEL FOR DATA FROM A SINGLE S-BAND STATION

31 JANUARY 1967

Prepared for
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05952-6115-R001

TRW NOTE NO. 67 FMT-279

7-2-16

PROJECT APOLLO
TASK MSC/TRW A-60.2

FOURTH INTERIM REPORT FOR LUNAR LANDING MISSIONS EARTH PHASE ABORT ANALYSES

30 JANUARY 1967

A B R I D G E M E N T

Prepared for
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05952-6116-T000

27 January 1967

SERVICE PROPULSION SYSTEM
PROPELLANT UTILIZATION AND GAUGING SYSTEM
SIMULATION

Prepared Under Contract NAS9-4810

Task MSC/TRW ASPO-19B

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TRW NOTE NO. 67 FMT-280

PROJECT APOLLO
TASK MSC/TRW A-116

ENTRY DEBRIS HAZARD EVALUATION FOR MISSION AS-501

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05952-6120-R000
1 February 1967

ENGINEERING MODEL FOR SERVICE PROPULSION SYSTEM

Prepared Under Contract
NAS 9-4810
Task MSC/TRW ASPO-19B

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05952-6121-ROOO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-42

20 MARCH 1967

APOLLO MISSION AS-258A PRELIMINARY SPACECRAFT DISPERSION ANALYSIS

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TRW NOTE NO. 67 FMT-282

PROJECT APOLLO
TASK MSC/TRW A-60.1

ANALYTIC FINITE BURN MODELS

15 FEBRUARY 1967

ABRIDGEMENT

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PROJECT APOLLO
TASK MSC/TRW A-60.1

ANALYTIC FINITE BURN MODELS

15 FEBRUARY 1967

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TRW NOTE NO. 67 FMT-284

PROJECT APOLLO
TASK MSC/TRW A-122

CM SEPARATION FROM THE SM + SLA + S-IVB DURING A MODE II ABORT WITH SLA FAILURE

27 FEBRUARY 1967

Prepared for
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#4

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. 67-FM-36

28 FEBRUARY 1967

EFFECT OF LAUNCH VEHICLE DESTRUCT ACTION ON THE AS–205/208 SPACECRAFT COMPONENTS

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TRW NOTE NO. 66 FMT-272

PROJECT APOLLO
TASK MSC/TRW A-4

EFFECT OF LAUNCH VEHICLE DESTRUCT ACTION ON LM AND LM ADAPTER FOR MISSION AS-206

ABRIDGEMENT

Prepared for
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TRW NOTE NO. 67 FMT-287

PROJECT APOLLO
TASK MSC/TRW A-48

S-BAND, POWERED FLIGHT TRACKING PROGRAMS

22 FEBRUARY 1967

Prepared for
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TRW NOTE NO. 67 FMT-290

PROJECT APOLLO
TASK MSC/TRW AA-5

INTERIM REPORT FOR DEVELOPMENT OF HYBRID COMPUTATIONAL METHODS FOR MISSION ABORT ANALYSIS

6 MARCH 1967

Prepared for
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05952-6135-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL

1 MARCH 1967

PART 1 OF 4

Prepared for
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05952-6135-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL

1 MARCH 1967

PART 2 OF 4

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05952-6135-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL

1 MARCH 1967

PART 3 OF 4

Prepared for
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05952-6135-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS)
PROGRAM USER'S MANUAL

1 MARCH 1967

PART 4 OF 4

Prepared for
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TRW NOTE NO. 67 FMT-286

PROJECT APOLLO
TASK MSC/TRW A-116

ENTRY DEBRIS HAZARD EVALUATION FOR MISSION AS-206

24 FEBRUARY 1967

Prepared for
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TRW NOTE NO. 67 FMT-292

PROJECT APOLLO
TASK MSC/TRW A-96

EVALUATION OF EDS ABORT SIGNALS FOR AS-204

10 MARCH 1967

Prepared for
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05952-H6139-R0-00

TRW NOTE NO. 67-FMT-293

PROJECT APOLLO
TASK MSC/TRW A-93

INTEGRATING MONTE CARLO PROGRAM
PROGRAM OPERATING INSTRUCTIONS

VOLUME II

26 JUNE 1967

Prepared for
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TRW NOTE NO. 67 FMT-297

PROJECT APOLLO
TASK MSC/TRW A-125

VOLUME I

REVISED PERFORMANCE EVALUATION PROGRAM (PEP) USER MANUAL

5 APRIL 1967

Prepared for
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TRW NOTE NO. 67 FMT-297

PROJECT APOLLO
TASK MSC/TRW A-125

VOLUME II

REVISED PERFORMANCE EVALUATION PROGRAM (PEP) USER MANUAL

5 APRIL 1967

Prepared for
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TRW NOTE NO. 67 FMT-291

PROJECT APOLLO
TASK MSC/TRW AA-8

NUMERICAL ERROR ANALYSIS OF THE SECOND-VARIATIONAL METHOD

10 MARCH 1967

Prepared for
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ENGINEERING MODEL FOR LUNAR MODULE DESCENT ENGINE SIMULATION

Prepared Under Contract
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LUNAR MODULE
Integrated Thermal Subsystem Analysis Program

Volume I
Program Operation

20 APRIL 1967

05952-6151-R000

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Prepared for
APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TASK NO. ASPO 48 (SUBTASK 05)
Under contract to
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS
NAS 9-4810

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LUNAR MODULE
Integrated Thermal Subsystem Analysis Program

Volume II
Detailed Program Logic

20 APRIL 1967

05952-6152-R000

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TRW NOTE NO. 67 FMT-296

PROJECT APOLLO
TASK MSC/TRW AA-5

SECOND INTERIM REPORT FOR DEVELOPMENT OF HYBRID COMPUTATIONAL METHODS FOR MISSION ABORT ANALYSIS

20 APRIL 1967

Prepared for
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05952-6158-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL - LUNAR MODULE

28 APRIL 1967

PART 1 OF 4

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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TRW NOTE NO. 67 FMT-295

PROJECT APOLLO
TASK MSC/TRW A-81

TARGETING ANALYSES FOR APOLLO LUNAR OPERATIONS

14 APRIL 1967

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05952-6158-R000

PROJECT APOLLO
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APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL - LUNAR MODULE

28 APRIL 1967

PART 3 OF 4

Prepared for
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NARA SW Box E209H-85

05952-6158-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL - LUNAR MODULE

28 APRIL 1967

PART 4 OF 4

Prepared for
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05952-6158-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL - LUNAR MODULE

28 APRIL 1967

PART 2 OF 4

Prepared for
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TRW NOTE NO. 67-FMT-528

PROJECT APOLLO
TASK MSC/TRW A-97

USE OF HYBRID SIMULATION FOR APOLLO SOFTWARE VALIDATION

6 JUNE 1967

Prepared for
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05952-6165-R000

PROJECT APOLLO

TASK MSC/TRW A-89

PROGRAM HYP3 INPUT-OUTPUT GUIDE

28 April 1967
Prepared for

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TRW NOTE NO. 67 FMT 299

PROJECT APOLLO
TASK MSC/TRW A-60.2

SUMMARY TECHNICAL REPORT FOR LUNAR LANDING MISSIONS EARTH PHASE CIRCUMLUNAR ABORT ANALYSIS

7 JUNE 1967

Prepared for
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TRW NOTE NO. 67 FMT-300

PROJECT APOLLO
TASK MSC/TRW AA-5

FINAL REPORT FOR DEVELOPMENT OF HYBRID COMPUTATIONAL METHODS FOR MISSION ABORT ANALYSIS

9 JUNE 1967

Prepared for
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ORACLE-MAFIA
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27 September 1967 05952-6178-T000

Prepared Under Contract NAS9-4810
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05952-6162-R000

PROJECT APOLLO
TASK MSC/TRW ASPO-15C

APOLLO SUBSYSTEMS INTERACTION SIMULATION (ASIS) PROGRAM USER'S MANUAL — CSM SUPPLEMENT (APPENDIX C)

10 MAY 1967

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
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NARA SW Box E209H-86

05952-6181-R000

TRW NOTE NO. 67 FMT-302

PROJECT APOLLO
TASK MSC/TRW AA-8

NUMERICAL ANALYSIS OF THE SECOND-VARIATIONAL METHOD

Prepared by
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27 OCTOBER 1967

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Summary Report on Optical and Thermal Control Coatings Degradation of the Apollo Spacecraft

31 October 1967

Report Number 05952-6182-R00

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center

Houston, Texas

Contract Number NAS 9-4810

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05952-6183-R000

TRW NOTE NO. 67 FMT-303

PROJECT APOLLO
TASK MSC/TRW A-96

ABORT LIMIT LINES DUE TO SATURN V AND APOLLO BLOCK II STRUCTURAL CONSTRAINTS

Prepared by
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3 NOVEMBER 1967

Prepared for
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TRW NOTE NO. 67 FMT-304

PROJECT APOLLO

TASK MSC/TRW A-96

SATURN LAUNCH VEHICLE SIMULATION USER'S MANUAL

27 NOVEMBER 1967

Volume I

Prepared for
MISSION PLANNING AND ANALYSIS DIVISION
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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05952-6184-R000

TRW NOTE NO. 67 FMT-304

PROJECT APOLLO

TASK MSC/TRW A-96

SATURN LAUNCH VEHICLE SIMULATION USER'S MANUAL

27 NOVEMBER 1967

Volume II

Prepared for
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TRW NO. 67 FMT-305

PROJECT APOLLO

TASK MSC/TRW A-96

EVALUATION OF EDS ABORT SIGNALS FOR AS-503

6 NOVEMBER 1967

Prepared for
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VISIBILITY DURING LUNAR LANDING

05952-~~6195~~-R000 January 19, 1968

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This report was prepared for Manned Spacecraft Center under NASA MSC Task E36-C Contract Number NAS 94810

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05952-6199-R0-00

PROJECT TECHNICAL REPORT

TASK E-70

REVIEW OF APOLLO COMMAND MODULE WATER LANDING LOADS

NAS 9-4810

25 MARCH 1968

Prepared for
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ORACLE-MAFIA
PROGRAM

Volume II

27 September 1967

05952-6178-T000

Prepared Under Contract NAS9-4810
Task MSC/TRW ASPO-19B

NARA SW Box E209H-87

PARAMETER SENSITIVITY LIST FOR COMMAND AND SERVICE MODULE SYSTEMS

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT - TASK E-74

NAS 9-4810

10 JULY 1968

Prepared for

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TRW NOTE NO. 68 FMT-309

PROJECT APOLLO
TASK MSC/TRW A-160

LUNAR LANDING MISSION ABORT TARGETING ANALYSIS TO SUPPORT RTCC LOGIC DEFINITION

28 JUNE 1968

Prepared for
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NAS 9-4810

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0592-6217-RO-00

CSM-103 DATA ANALYSIS PLAN

MISSION "D"

TASK E-74

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-4810

18 JULY 1968

Prepared for

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LANDMARK VISIBILITY DURING LUNAR DESCENT

VOLUME I

05952-6220-R0-00 July 23, 1968

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This report was prepared for Manned Spacecraft Center under NASA MSC Task E-71 Contract Number NAS9-4810

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LANDMARK VISIBILITY DURING LUNAR DESCENT

VOLUME II

05952-6220-R0-00 July 23, 1968

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This report was prepared for Manned Spacecraft Center under NASA MSC Task E-71 Contract Number NAS9-4810

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TRW NOTE NO. 68 FMT-307

PROJECT APOLLO
TASK MSC/TRW AA-8

NUMERICAL ANALYSIS OF THE SECOND-VARIATIONAL METHOD

4 APRIL 1968

Prepared for
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PROJECT TECHNICAL REPORT
TASK E-79

APOLLO SATURN SPACE VEHICLE
POGO ANALYSIS, ADDENDUM 1

NAS 9-8166

20 SEPTEMBER 1968

Prepared for
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PROJECT TECHNICAL REPORT
TASK E-79

APOLLO SATURN SPACE VEHICLE POGO ANALYSIS, ADDENDUM 2

NAS 9-8166

20 DECEMBER 1968

Prepared for
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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8N-021 A

JUNE 23, 1969

APOLLO MISSION TECHNIQUES
MISSION G LUNAR DESCENT
REVISION A

TECHNIQUES DESCRIPTION

APOLLO SPACECRAFT PROGRAM OFFICE
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111776-H009-R0-00

PROJECT TECHNICAL REPORT

TASK E-45A

FOURTH SUMMARY REPORT

NAS 9-8166

31 JULY 1968

Prepared for
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PROJECT TECHNICAL REPORT
TASK E-79

APOLLO SATURN SPACE VEHICLE
POGO ANALYSIS

NAS 9-8166

31 JULY 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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PRELIMINARY ERROR MODELS OF APOLLO 16 PIPA AND 25 IRIG

TASK ASPO 27

NAS 9-4810

14 January 1966

Prepared For
National Aeronautics and Space Administration
Manned Spacecraft Center

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TRW Systems
One Space Park
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REVISED PROGRAM PLAN FOR LEM AND CSM CONTROL SYSTEM STUDIES (ASSAP Task 27.2)

2224-6002-T0000

30 November 1965

Prepared by: A. M. Frew

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Apollo G&C Project

Approved by: SIGNED
H. I. Leon, Assistant Director for Systems Analysis, Apollo Spacecraft System Analysis Program

Contract No. NAS 9-480

Prepared for

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REPORT ON THE JANUARY 12, 1966 MIT/MSC TECHNICAL INTERCHANGE MEETING ON THE LEM DIGITAL AUTOPILOT TASK ASPO 27

NAS 9-4810

21 January 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

ASSAP

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NARA SW Box E209H-8

2224-6006-T0-000

PROGRAM TECHNICAL REPORT
TASK ASPO 27

PRELIMINARY RELEASE OF THE CSM DIGITAL AUTOPILOT THRUST VECTOR CONTROL SYSTEM ANALYSIS RESULTS

NAS 9-4810

25 MARCH 1966

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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ASSAP

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LEM LANDING RADAR OPERATIONAL PERFORMANCE

BY

ALEXANDER A. DZILVELIS

PREPARED FOR
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NAS 9-4810

2 JUNE 1966

2224-6008-R0000

TRW SYSTEMS

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2224-6009-T0-000

PROJECT TECHNICAL REPORT
TASK ASPO-36

ANALYSIS OF THE APOLLO BLOCK II CSM THRUST VECTOR CONTROL SYSTEM

Prepared for
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2224-6011-R0-001

PROJECT TECHNICAL REPORT
TASK ASPO-27

AUTOMATIC LUNAR LANDING GUIDANCE PERFORMANCE ANALYSIS STUDY

NAS 9-4810

22 AUGUST 1966

Prepared for
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2231-H001-R0-000

APOLLO SPACECRAFT SYSTEM ANALYSIS PROGRAM

TECHNICAL REPORT

ASPO TASK 9B

APOLLO COMMUNICATIONS SYSTEM ANALYSIS

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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NAS 9-4810

20 JULY 1966

TRW SYSTEMS

NARA SW Box E209H-8

2225-6002-R0-000
NAS9-4810

8 February 1966

Final Report
ASSAP Task 32
Interim AGS Software Analysis

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LEM Guidance and Navigation Section

Approved:

W.J. Klunk, Task Manager

Approved:

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S-BAND COMMUNICATION AND RANGING STUDY
MONTHLY REPORT

NASA MSC/TRW TASK ASPO-9

2231-6001-RU000

September 1, 1965

Prepared for
Manned Spacecraft Center
National Aeronautics and Space Administration
Under
Contract No. NAS 9-4810

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S-BAND COMMUNICATION AND RANGING STUDY
MONTHLY REPORT

NASA MSC/TRW TASK ASPO-9

2231-6002-SU000

October 1, 1965

Prepared for
Manned Spacecraft Center
National Aeronautics and Space Administration
Under
Contract No. NAS 9-4810

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2223-6002-T0000

GUIDANCE & CONTROL SYSTEM TEST PLANNING AND EVALUATION

Task ASPO 26A

AN EVALUATION OF THE APOLLO GN&C GROUND TEST PROGRAM

10 March 1966

Prepared by

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Prepared for

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NAS 9-4810

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11176-H013-TO-00

LM AND CSM S-BAND ANTENNA TRACKING STUDIES
TASK E-53C

ENGINEERING REPORT

INTERCHANGEABILITY STUDY—DATA ACQUISITION STATUS REPORT

---

9 AUGUST 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-8166

TRW
SYSTEMS GROUP

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

ENGINEERING REPORT

TASK E-34D

NAS9-8166

9 August 1968

INTERIM LR REFLECTIVITY MODEL

Prepared for

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ASPL

11176-H020-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 AUGUST 1968

Prepared for

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PROJECT TECHNICAL REPORT
TASK E-9D

COMMUNICATIONS SIMULATION PROGRAM
(COMSIM) HV008C

NAS 9-8166

15 AUGUST 1968

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PROJECT TECHNICAL REPORT

TASK E-9E

COMMUNICATIONS SIMULATION PROGRAM

(CØMSIM) HV008C

NAS 9-8166

Basic 15 August 1968
Changed 25 April 1969

Prepared for

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11176-H023-R0-00

PROJECT TECHNICAL REPORT
TASK E-9D

ANALYSIS OF REDUCTION IN THE 1.024 MHz TELEMETRY SUBCARRIER MODULATION INDEX

NAS 9-8166

21 AUGUST 1968

Prepared for
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11176-H024-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TASK E-78A

NAS9-8166

22 AUGUST 1968

PERFORMANCE ASSESSMENT OF THE APOLLO VHF COMMUNICATION SYSTEM

ANALYSIS OF MULTIPATH GEOMETRY

Prepared For

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11176-H025-R0-00

PROJECT TECHNICAL REPORT
TASK E&D-38

G&C POSTFLIGHT ANALYSIS MASTER PLAN

NAS 9-8166

15 AUGUST 1968

Prepared for
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11176-H026-RO-00

LM-4 DATA ANALYSIS PLAN

MISSION "E"

TASK E-74

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

26 AUGUST 1968

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111 76-H028-R0-00

P R O J E C T T E C H N I C A L R E P O R T

REACTION CONTROL SYSTEM
INTEGRATED SYSTEMS PERFORMANCE ANALYSIS
LM COMPUTER PROGRAM
USER'S MANUAL

NAS 9-8166

30 August 1968

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-78A

NAS9-8166 1 August 1968

BIMONTHLY TECHNICAL REPORT
NUMBER 1

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H033-R0-00

PROJECT TECHNICAL REPORT
MSC/TRW TASK E-72A

DIGITAL AUTOPILOT VERIFICATION TEST RESULTS SUMMARY USING SUNDISK PROGRAM FOR MISSION C

NAS 9-8166

6 SEPTEMBER 1968

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11176-H034-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 SEPTEMBER 1968

Prepared for

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11176-H035-R0-00

APOLLO COMMUNICATIONS SYSTEMS
TASK E-59B
TECHNICAL REPORT

MEASUREMENT OF INCIDENTAL AMPLITUDE MODULATION

16 SEPTEMBER 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

Under

Contract No. NAS 9-8166

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11176-H037-R0-00

PROJECT TECHNICAL REPORT

TASK ASPO-76

APOLLO TECHNICAL DATA MANAGEMENT PLAN (DRAFT)

NAS 9-8166

30 SEPTEMBER 1968

Prepared for
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11176-H038-R0-00

LM-5 PARAMETER SENSITIVITY ANALYSIS DOCUMENTATION REPORT

MISSION "F"

TASK E-74

HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

26 September 1968

Prepared for

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11176-H039-R0-00

PROJECT TECHNICAL REPORT

TASK E-78A

BIMONTHLY TECHNICAL REPORT
NUMBER 2
VOLUME I

NAS 9-8166

1 OCTOBER 1968

Prepared for
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11176-H040-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

HYBRID SIMULATOR CONSTANTS REVIEW FOR MISSION D (PRELIMINARY REVIEW OF GAEC SIMULATOR CONSTANTS)

NAS 9-8166

27 SEPTEMBER 1968

Prepared for
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11176-H041-R0-00

PROJECT TECHNICAL REPORT
TASK E-38

APOLLO 7
GN&C PREFLIGHT PERFORMANCE REVIEW

NAS 9-8166

20 SEPTEMBER 1968

Prepared for
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PROJECT TECHNICAL REPORT
TASK E-38B

AS-205/101 GUIDANCE NAVIGATION AND CONTROL SYSTEM FLIGHT TEST ANALYSIS PLAN

NAS 9-8166

11 SEPTEMBER 1968

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

30 September 1968

RANGE COVERAGE FOR THE CSM RENDEZVOUS RADAR TRANSPONDER ANTENNA RAISED 4" AND TILTED FORWARD 15°

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Contract No:
NAS 9-8166

TRW Report No:
11176-H045-R0-00

APOLLO VISIBILITY HANDBOOK

4 October 1968

Prepared for
SYSTEMS ENGINEERING DIVISION
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MANNED SPACECRAFT CENTER
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By
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Contract No:
NAS 9-8166

TRW Report No:
11176-H046-R0-00

COMPUTATION OF LIGHTING AND VIEWING ANGLES

4 October 1968

Prepared for
SYSTEMS ENGINEERING DIVISION
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Contract No:
NAS 9-8166

TRW Report No:
11176-H047-RO-00

APOLLO MISSION D EVA VISIBILITY

4 October 1968

Prepared for
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11176-H048-R0-00

REVIEW OF

STUDY ANALYSIS REPORT SD68-452

MISSION EVALUATION ME-101

HYBRID SIMULATOR DATA MANAGEMENT

SUPPORT - TASK E-74

NAS9-8166

13 SEPTEMBER 1968

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. S-PA-8T-025

APOLLO MISSION TECHNIQUES
MISSION G
LUNAR SURFACE PHASE

TECHNIQUES DESCRIPTION

October 6, 1968

APOLLO SPACECRAFT PROGRAM OFFICE
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11176-H050-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 OCTOBER 1968

Prepared for
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11176-H051-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

11 OCTOBER 1968

CALIBRATION FOR PROJECT PEARL ANTENNA ATTITUDE VERSUS LN-12 READINGS

Prepared by

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H051-R0-01

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

10 DECEMBER 1968

CALIBRATION FOR PROJECT PEARL ANTENNA ATTITUDE VERSUS LN-12 READINGS

(REVISION I)

Prepared by

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APOLLO COMMUNICATION SYSTEMS
TASK E-59B
TECHNICAL REPORT

LM-5 TELEMETRY SYSTEM PERFORMANCE

BIT TRANSITION DENSITY REPORT

REVISION A

---

7 July 1969

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under
Contract No. NAS 9-8166

TRW
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APOLLO COMMUNICATION SYSTEMS
TASK E-59B
TECHNICAL REPORT

LM-5 TELEMETRY SYSTEM PERFORMANCE
BIT TRANSITION DENSITY REPORT

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15 October 1968

Prepared For

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Under

Contract No. NAS 9-8166

TRW SYSTEM

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FILE

11176-H053-R0-00

PROJECT TECHNICAL REPORT
TASK E-38B

OPTICAL SUBSYSTEM POST-FLIGHT EVALUATION PLAN

NAS 9-8166

17 OCTOBER 1968

Prepared for
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11176-H042-R0-00

PROJECT TECHNICAL REPORT
TASK E-78A

BIMONTHLY TECHNICAL REPORT
NUMBER 2
VOLUME II

NAS 9-8166

1 OCTOBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H059-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TECHNICAL REPORT
TASK E-34D

NAS9-8166

25 OCTOBER 1968

LANDING RADAR ALTIMETER BEAM BANDWIDTH AND DOPPLER EQUATIONS FOR MATHEMATICAL MODEL USE

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H060-R0-00

PROJECT TECHNICAL REPORT

PROPULSION SYSTEMS DISPERSION ANALYSIS AND OPTIMUM PROPELLANT MANAGEMENT

NAS 9-8166

28 October 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Task E-19D

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11176-H061-R0-00

PROJECT TECHNICAL REPORT

MSC/TRW TASK E-72A

SUPPLEMENT 4 TO APOLLO 5 MISSION REPORT - ANALYSIS OF DIGITAL AUTOPILOT PERFORMANCE

NAS 9-8166

29 OCTOBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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FILE

11176-H063-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
TECHNICAL REPORT
TASK E-34D

NAS9-8166

21 OCTOBER 1968

DEBYE'S CONSTRUCTION OF VECTOR WAVE FUNCTIONS FROM SCALAR WAVE FUNCTIONS

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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TRW 11176-H064-R0-00

CONSTANTS REVIEW
OF
NORTH AMERICAN-ROCKWELL ME-101

HYBRID SIMULATOR DATA MANAGEMENT
SUPPORT - TASK E-74

NAS9-8166

1968 OCTOBER 14

Prepared for

National Aeronautics and Space Administration
Manned Spacecraft Center
Houston, Texas

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NARA SW Box E209H-93

11176-H066-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

4 November 1968

ANALYSIS OF RENDEZVOUS RADAR PEARL FLIGHT TEST DATA

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H069-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

COLOSSUS-103
ME-103 SFRR/FRR DISCREPANCY REPORT
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

6 NOVEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

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11176-H070-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 NOVEMBER 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

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PROJECT TECHNICAL REPORT

TASK E-74

LM-3 CTR DATA ANALYSIS
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

18 NOVEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H072-R0-00

APOLLO COMMUNICATION SYSTEMS
TASK E-59B
TECHNICAL REPORT

TEST ACCURACY ANALYSIS OF DOWNLINK PM TELEMETRY FOR ELECTRONIC SYSTEMS COMPATIBILITY LABORATORY

22 November 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-8166

TRW
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NARA SW Box E209H-93

11176-H074-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

LUMINARY - LM-4
FACI DISCREPANCY REPORT
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

5 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-93

11176-H075-R0-00

PROJECT TECHNICAL REPORT
TASK E-45B

FIRST SUMMARY REPORT

NAS 9-8166

22 NOVEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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TRW
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11176-H058-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

25 October 1968

ANALYSIS OF THE RENDEZVOUS RADAR RANGE MEASUREMENT LOGIC CIRCUITRY

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H079-R0-00

PROJECT TECHNICAL REPORT

TASK E-38

APOLLO 8

GN&C PREFLIGHT PERFORMANCE REVIEW

NAS 9-8166

25 NOVEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H080-R0-00

APOLLO LM AND CSM S-BAND ANTENNA TRACKING STUDIES
TASK E-53C-1
TECHNICAL REPORT

NAS9-8166

2 December 1968

CSM-HGA INTERCHANGEABILITY STUDY
ANTENNA AND RF CIRCUITRY ANALYSIS

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-94

11176-H082-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

HYBRID SIMULATOR CONSTANTS REVIEW FOR MISSION D (PRELIMINARY REVIEW OF GAEC SIMULATOR CONSTANTS)

NAS 9-8166

2 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
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Electronic Systems Laboratory

TRW SYSTEMS GROUP

NARA SW Box E209H-94

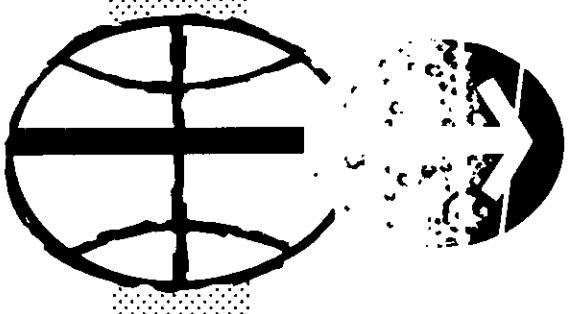
11176-H084-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. EB-R-68-15

December 10, 1968

APOLLO COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR MISSION APOLLO 8



INFORMATION SYSTEMS DIVISION
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11176-H085-R0-00

PROJECT TECHNICAL REPORT

TASK E-53

AN INVESTIGATION OF THE MULTIPATH PROBLEMS ASSOCIATED WITH THE APOLLO CSM AND LM S-BAND HIGH GAIN COMMUNICATION ANTENNA TRACKING SYSTEMS

NAS 9-8166

16 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H086-R0-00

PROJECT TECHNICAL REPORT

TASK E-72A

COLOSSUS RCS DIGITAL AUTOPILOT SOFTWARE VERIFICATION TEST RESULTS SUMMARY FOR MISSION C-PRIME

NAS 9-8166

11 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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11176-H087-R0-00

LM AND CSM S-BAND ANTENNA TRACKING STUDIES

TASK E-53C-1

TECHNICAL REPORT

ELECTRONICS ASSEMBLY INTERCHANGEABILITY STUDY
VOLUME I
SMALL SIGNAL ANALYSIS

---

13 DECEMBER 1968

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-8166

TRW
SYSTEMS GROUP

NARA SW Box E209H-94

11176-H088-R0-00

MONTHLY PROGRESS REPORT

APOLLO SPACECRAFT
SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 DECEMBER 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

TRW SYSTEMS GROUP

NARA SW Box E209H-94

11176-H077-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

26 November 1968

A COMPARISON OF THE COMPUTED LR RECEIVED SIGNAL SPECTRUM AND THE 1967 PEARL DATA

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-94

NAS 9-8166

SECOND QUARTERLY PROGRESS REPORT

TASK E&DD E-66A

11176-H090-RO-00

16 December 1968

Prepared for
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Manned Spacecraft Center
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11176-H095-RO-00

PROJECT TECHNICAL REPORT

TASK E&D-38

APOLLO VII GUIDANCE, NAVIGATION AND CONTROL SYSTEM PERFORMANCE ANALYSIS - FINAL REPORT

NAS 9-8166

20 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Electronic Systems Laboratory

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LM AND CSM S-BAND ANTENNA TRACKING STUDIES
TASK E-53C

ENGINEERING REPORT

TESTING THE CSM S-BAND HIGH GAIN ANTENNA SERVO

---

13 DECEMBER 1968

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-8166

TRW
SYSTEMS GROUP

NARA SW Box E209H-95

11176-H097-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

PRELIMINARY PARAMETER SENSITIVITY ANALYSIS OF THE LM-ACTIVE PHASES OF MISSION F

NAS 9-8166

26 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-95

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

31 DECEMBER 1968

PRELIMINARY LR REFLECTIVITY MODEL

Prepared by

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-95

11176-H099-R0-00

PROJECT TECHNICAL REPORT
TASK E-78A-1

BIMONTHLY TECHNICAL REPORT
NUMBER 3

NAS 9-8166

7 JANUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-95

11176-H100-R0-00

PROJECT TECHNICAL REPORT
TASK E&DD E-45B

COMPARISONS OF MEASURED AND PREDICTED HEAT SHIELD PERFORMANCE FOR THE APOLLO 7 (AS-205) MISSION

NAS 9-8166

30 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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11176-H101-R0-00

APOLLO LM AND CSM S-BAND ANTENNA TRACKING STUDIES
TASK E-53C-1
TECHNICAL REPORT

NAS9-8166

18 December 1968

CSM-HGA INTERCHANGEABILITY STUDY
ERROR ANALYSIS OF THE MONOPULSE COMPARATORS

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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11176-H108-R0-00

PROJECT TECHNICAL REPORT
TASK E-74

MISSION F PARAMETER SENSITIVITY ANALYSIS
FINAL REPORT - LM-ACTIVE PHASES

NAS 9-8166

15 JANUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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11176-H109-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

SUNDANCE-LM-3
SFRR DISCREPANCY REPORT
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

20 JANUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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PROJECT TECHNICAL REPORT

TASK E-74

REVIEW OF GAEC FMES/FCI HYBRID SIMULATOR CONTROL DATA FOR LM-3 D MISSION AND LM-4 F MISSION

NAS 9-8166

20 JANUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H111-R0-00

PROJECT TECHNICAL REPORT
TASK E-64A

APOLLO CSM/LM COMPUTERIZED ELECTROMAGNETIC COMPATIBILITY ANALYSIS

NAS 9-8166

21 JANUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H112-R0-00

PROJECT TECHNICAL REPORT

LM-1 DPS VALVE PHASING ANOMALY INVESTIGATION

NAS 9-8166

31 January 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H113-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

COLOSSUS-104
ME-104 SFRR DISCREPENCY REPORT
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

20 JANUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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NARA SW Box E209H-95

11176-H114-R0-00

PROJECT TECHNICAL REPORT
TASK E-74

LM-3 FINAL DATA ANALYSIS

NAS 9-8166

22 JANUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

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11176-H089-R0-00

PROJECT TECHNICAL REPORT
TASK E-64A

APOLLO CSM COMPUTERIZED ELECTROMAGNETIC COMPATIBILITY ANALYSIS

NAS 9-8166

6 DECEMBER 1968

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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11176-H129-R0-00

PROJECT TECHNICAL REPORT

TASK E-53C

CSM-HGA INTERCHANGEABILITY STUDY-ANTENNA AND RF CIRCUITRY TERMINAL CHARACTERISTICS ENVELOPE

NAS 9-8166

7 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Communications and Sensor Systems Department
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PROJECT TECHNICAL REPORT
TASK MSC/TRW ASPO-83

LAUNCH MISSION RULES INPUTS FOR APOLLO "F" TYPE MISSION, SPACECRAFTS CSM 106 AND LM-4

NAS 9-8166

7 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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Operations Analysis Section

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PROJECT TECHNICAL REPORT

TASK E-74

LM-5 DATA ANALYSIS PLAN MISSION G
HYBRID SIMULATOR DATA MANAGEMENT SUPPORT

NAS 9-8166

5 MARCH 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
Guidance and Control System Department
Electronics Systems Laboratory

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NARA SW Box E209H-96

11176-H134-R0-00

MSC INTERNAL NOTE NO. S-PA-9T-41

APOLLO MISSION TECHNIQUES
MISSIONS F AND G
TRANSLUNAR MIDCOURSE CORRECTIONS AND LUNAR ORBIT INSERTION
VOLUME I
TECHNIQUES DESCRIPTION

February 17, 1969

APOLLO SPACECRAFT PROGRAM OFFICE
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Howard W. Tindall, Jr., Chief
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NARA SW Box E209H-96

11176-H135-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

NAS 9-8166

15 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-96

PROJECT TECHNICAL REPORT
TASK E-74

PRELIMINARY MISSION G PARAMETER SENSITIVITY ANALYSIS REPORT-LM-ACTIVE PHASES

NAS 9-8166

17 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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HOUSTON, TEXAS

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NARA SW Box E209H-96

11176-H139-R0-00

PROJECT TECHNICAL REPORT

TASK E-38B

AS-504/CSM-104/LM-3 GUIDANCE NAVIGATION AND CONTROL SYSTEM FLIGHT TEST ANALYSIS PLAN, VOLUME 1

NAS 9-8166

14 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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PROJECT TECHNICAL REPORT

TASK E-38B

AS-504/CSM-104/LM-3 GUIDANCE NAVIGATION AND CONTROL SYSTEM FLIGHT TEST ANALYSIS PLAN, VOLUME II

NAS 9-8166

14 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
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DMG RKW PGW

11176-H143-R0-00

TRW NOTE NO. 69-FMT-736

PROJECT APOLLO
TASK MSC/TRW A-60.1

ANALYTIC RETURN-TO-EARTH PROGRAM - MOON REFERENCE
VOLUME I - USER'S MANUAL

4 MARCH 1969

Prepared for
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NAS 9-8166

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1176-H127-R0-00

PROJECT TECHNICAL REPORT
TASK E-64A

APOLLO LM-3 COMPUTERIZED ELECTROMAGNETIC COMPATIBILITY ANALYSIS

NAS 9-8166 5 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H149-R0-00

PROJECT TECHNICAL REPORT
TASK E-72A

DIGITAL AUTOPILOT SOFTWARE VERIFICATION TEST RESULTS SUMMARY FOR MISSION D - SUNDANCE AND COLOSSUS 1A

NAS 9-8166

21 FEBRUARY 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H153-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

ANALYSIS OF CSM-101 RENDEZVOUS RADAR OVERFLIGHT TEST DATA

TASK E-34D

21 February 1969

TRW SYSTEMS GROUP

NARA SW Box E209H-97

11176-H153-R0-01

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

7 APRIL 1969

ANALYSIS OF CSM-101 RENDEZVOUS RADAR OVERFLIGHT TEST DATA

REVISION I

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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NARA SW Box E209H-97

Report Number 11176-H155-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

COMPARISON OF LUNAR AND WSMR DIELECTRIC CONSTANTS

TASK E-34D

19 February 1968

TRW SYSTEMS GROUP

NARA SW Box E209H-97

PROJECT TECHNICAL REPORT

TASK E-78A

BIMONTHLY TECHNICAL REPORT
NUMBER 4
VOLUME I

NAS 9-8166

5 MARCH 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

TRW
SYSTEMS GROUP

NARA SW Box E209H-97

11176-H170-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

MISSION G PARAMETER SENSITIVITY ANALYSIS
FINAL REPORT
LM-ACTIVE PHASES

NAS 9-8166

10 MARCH 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

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11176-H176-R0-00

PROJECT TECHNICAL REPORT

TASK E-74

REVIEW OF GAEC FMES/FCI HYBRID SIMULATOR MATH MODELS AND CONTROL DATA FOR LM-4 F MISSION

NAS 9-8166

25 MARCH 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Prepared by
Guidance and Control Systems Department
Electronic Systems Laboratory

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11176-H178-R0-00

PROJECT TECHNICAL REPORT

APOLLO 8
CSM 103
SERVICE PROPULSION SYSTEM
FINAL FLIGHT EVALUATION

NAS 9-8166

4 April 1969

Prepared for
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Task E-19D

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SAVE FOR CONFIG. INFO.

TRW NOTE NO. 69-FMT-747

PROJECT APOLLO
TASK MSC/TRW A-215

APOLLO REFERENCE MISSION PROGRAM - VERSION 07
LUNAR DESCENT/ASCENT SUPPLEMENT
USER'S MANUAL

4 April 1969

Prepared for
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NAS 9-8166

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PROJECT TECHNICAL REPORT
TASK E-9E

ANALYSIS OF THE SPURIOUS SPECTRAL COMPONENTS APPEARING ABOUT THE S-BAND CARRIER

NAS 9-8166

9 MAY 1969

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

4 APRIL 1969

ANALYSIS OF MISSION "D" RENDEZVOUS RADAR AGC FLUCTUATION

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H191-R0-00

PROJECT TECHNICAL REPORT

TASK E-79

APOLLO SATURN SPACE VEHICLE POGO ANALYSIS AS-504 VEHICLE, S-IC STAGE

NAS 9-8166

25 APRIL 1969

Prepared for
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HUNTSVILLE, ALABAMA

Prepared by
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PROJECT TECHNICAL REPORT

TASK E-79

APOLLO SATURN SPACE VEHICLE POGO ANALYSIS S-II STAGE

NAS 9-8166

27 MAY 1969

Prepared for
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Spacecraft Systems Analysis
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11176-H145-R0-00

PROJECT TECHNICAL REPORT

TASK E-19A

ANALYSIS OF THE APOLLO DESCENT PROPULSION SYSTEM CASCADE PRESSURIZATION TESTS

NAS 9-8166

13 FEBRUARY 1969

Prepared for
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11176-H195-R0-00

PROJECT TECHNICAL REPORT
TASK E-64A

APOLLO 10 CSM/LM COMPUTERIZED ELECTROMAGNETIC COMPATIBILITY ANALYSIS

NAS 9-8166

15 APRIL 1969

Prepared for
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11176-H196-R0-00

APOLLO COMMUNICATION SYSTEMS
TASK E-59B
TECHNICAL REPORT

LM STEERABLE ANTENNA
LOOK ANGLE CONVERSIONS

14 April 1969

Prepared for

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Under

Contract No. NAS 9-8166

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11176-H197-R0-00

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

14 APRIL 1969

EXPERIMENTAL INVESTIGATION OF LR TRACKER PERFORMANCE

Prepared For

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H200-R0-00

PROJECT TECHNICAL REPORT

TASK E-38B

APOLLO VIII GUIDANCE, NAVIGATION AND CONTROL SYSTEM PERFORMANCE ANALYSIS FINAL REPORT

NAS 9-8166

15 APRIL 1969

Prepared for
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

TECHNICAL REPORT

TASK E-34D

NAS9-8166

18 APRIL 1969

LUNAR RENDEZVOUS MULTIPATH STUDY

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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LM AND CSM S-BAND ANTENNA TRACKING STUDIES

TASK E-53C-2

TECHNICAL REPORT

LINEAR INTERCHANGEABILITY STUDY OF THE CSM HGA TRACKING SYSTEM

NAS 9-8166

16 APRIL 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Electronics Systems Laboratory

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11176-H204-R0-00

PROJECT TECHNICAL REPORT

TASK E-38B

AS-505/CSM-106/LM-4 GUIDANCE NAVIGATION AND CONTROL SYSTEM DATA PROCESSING PLAN

NAS 9-8166

22 APRIL 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
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Prepared by
Guidance and Control Systems Department

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11176-H206-R0-00

PROJECT TECHNICAL REPORT
TASK ASPO-32

PLAN FOR MSC SIMULATOR TESTING OF FPX

NAS 9-8166

APRIL 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

Prepared by
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NARA SW Box E209H-98

11176-H193-R0-00

BIMONTHLY PROGRESS REPORT

SPACECRAFT SYSTEMS ANALYSIS PROJECT

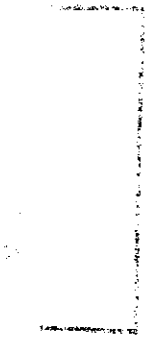
NAS 9-8166

15 APRIL 1969

Master

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS

*70-28156



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NARA SW Box E209H-98

11176-H208-R0-01

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

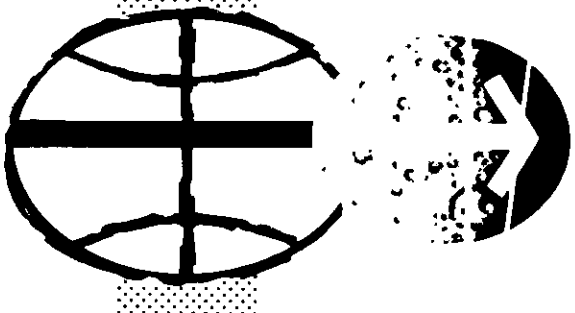
MSC INTERNAL NOTE NO. EB-R-69-5

MAY 5, 1969

ADDENDUM 1 COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR APOLLO 10 (F TYPE MISSION)

By Communications Systems Section
TRW Systems Group

MSC Task Monitor
G. D. Arndt



INFORMATION SYSTEMS DIVISION
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HOUSTON, TEXAS

NARA SW Box E209H-99

11176-H208-R0-02

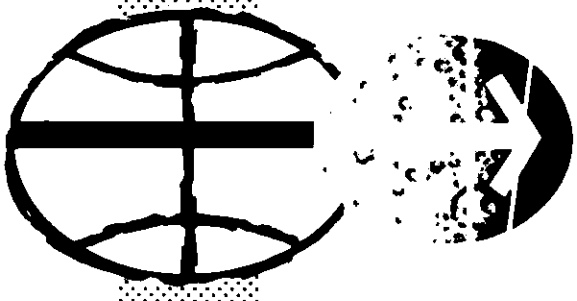
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE NO. EB-R-69-5

MAY 14, 1969

ADDENDUM 2

COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR APOLLO 10 (F TYPE MISSION)



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11176-H211-R0-00

PROJECT TECHNICAL REPORT

TASK E-78A

APOLLO MISSION F
SPACECRAFT TO SPACECRAFT VHF COVERAGE

NAS 9-8166

28 APRIL 1969

Prepared for
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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11176-H208-R0-00

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

MSC INTERNAL NOTE N. . EB-R-69-5

APRIL 30, 1969

COMMUNICATION SYSTEMS PERFORMANCE AND COVERAGE ANALYSIS FOR APOLLO 10 (F TYPE MISSION)

MANNED SPACECRAFT CENTER

HOUSTON, TEXAS

MSC FORM 2026A (REV MAY 68

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 9A
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

2231-6005-T0000

1 January 1966

Prepared for
NASA MANNED SPACECRAFT CENTER
Houston, Texas
Under
Contract No. NAS9-4810

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APOLLO SPACECRAFT

FINAL REPORT

ASPO TASK 18
LEM AND CSM USB SYSTEM RF TRACKING STUDY

2231-6006-T0-000

January 1966

Prepared for
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Houston, Texas
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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 9A
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

2231-6007-T0-000 1 February 1966

Prepared for
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MONTHLY PROGRESS REPORT

ASPO TASK 9A
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

2231-6008-T0-000

1 March 1966

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THRESHOLD IN MODULATION TRACKING LOOPS EMPLOYING PERIODIC PHASE DETECTORS

July 1966

2231-6009-RU-000

Prepared for
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MONTHLY PROGRESS REPORT

ASPO TASK 9A
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

2231-6010-T0-000

1 April 1966

Prepared for
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MONTHLY PROGRESS REPORT

ASPO TASK 9A
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

2231-6011-TO-000 1 May 1966

Prepared for
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SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO Task 9A

Unified S-Band Communication and Ranging Performance Study

1 JUNE 1966

Prepared for
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Houston, Texas

Under
Contract No. NAS9-4810

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2240-H001-T0-000

PROJECT TECHNICAL REPORT
TASK ASPO-34A

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM
QUARTERLY PROGRESS REPORT
RADAR PERFORMANCE ASSESSMENT

NAS 9-4810

1 JULY 1966

Prepared for
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2240-H001-TO-000

APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 34

RADAR PERFORMANCE ASSESSMENT

Prepared for

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MANNED SPACECRAFT CENTER

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NAS 9-4810

1 JUNE 1966

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2240-H002-R0-000

RENDEZVOUS RADAR BORESIGHT TEST PLAN

ASPO-34A

Prepared for

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NAS 9-4810

12 JULY 1966

TRW SYSTEMS

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MONTHLY STATUS REPORT

for the Study of

DFI GSE AND GROUND TEST VEHICLES

15 SEPTEMBER 1965

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MONTHLY STATUS REPORT

for the Study of

DFI GSE AND GROUND TEST VEHICLES

15 OCTOBER 1965

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APOLLO SPACECRAFT SYSTEMS ANALYSIS PROGRAM

MONTHLY PROGRESS REPORT

ASPO TASK 9A
UNIFIED S-BAND COMMUNICATION AND RANGING PERFORMANCE STUDY

2231-6004-SU-000

1 November 1965

Prepared for
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